

# U.S. SORGHUM INDUSTRY

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#### ABSTRACT

Sorghum has become a major feed grain crop in recent years, complementing the development of the feedlot industry in the Southwest where most U.S. sorghum is produced. About 72 percent of the crop is fed domestically; exports account for 26 percent. Seed, food, and industrial use totaled less than 1 percent of total demand in the past 10 years. The entire U.S. sorghum subsector, from producer to end-user, is described as are the factors affecting supply and demand: production costs, supply trends, production geography, stock levels, Government policy, market structure, prices, and world production and trade.

KEYWORDS: Sorghum, Feed grain, Production stocks, Feed use, Exports, Market structure, Prices, Production costs, Policy, World production, World trade.

#### PREFACE

This publication is one of a series of ESCS descriptive studies of major U.S. food and feed grains. Already published are:

- . U.S. Rice Industry, by Shelby H. Holder, Jr., and Warren R. Grant (AER-433).
- . U.S. Wheat Industry, by Walter G. Heid, Jr. (AER-432).
- . U.S. Barley Industry, by Walter G. Heid, Jr., and Mack N. Leath (AER-395).

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## HIGHLIGHTS

U.S. sorghum production is concentrated in the southern half of the Great Plains, with about 80 percent of the 1970-78 production occurring in Texas, Kansas, and Nebraska. Production rose sharply after the 1956 introduction of hybrid sorghum.

Sorghum became an important U.S. feed grain crop after World War II. Domestic feed use during 1970-78 accounted for 72 percent of total demand, while exports were 27 percent. Food, seed, and industrial use comprised less than 1 percent.

The Southwest feedlot industry should remain large, assuming no drastic economic changes or shifts in consumer attitudes and wants. Major factors affecting sorghum consumption in the Southwest are sorghum prices relative to other feed grains (especially corn), beef prices, and feeding rates.

The United States produced about 30 percent of the total world sorghum during 1960 to 1979 and has supplied an average of 67 percent of annual world exports since 1949. Japan is the largest U.S. customer. Argentina, Australia, and the United States supply about 90 percent of the world's sorghum exports. World trade quadrupled from 1960 to 1978, fluctuating from a low of 2.6 million metric tons in 1960 to a high of 11.9 million metric tons in 1976. The export market is expected to grow.

World sorghum production rose from 43.1 million metric tons in 1960 to a high of 70.5 million in 1977, an increase of 59 percent. Higher yields, resulting from expanded fertilizer use, improved technology, and sorghum hybrids, accounted for most of the increased production.



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## INTRODUCTION

Sorghum is a major livestock and poultry feed and human food in many countries where climates are relatively warm. Sorghum ranks fifth in total acreage among the crops of the world, behind wheat, rice, corn, and barley. More than 45.9 million hectares (113.4 million acres) were harvested in 1979.

The United States is a major sorghum producer and exporter, and uses sorghum for feed, forage, seed, food, and industrial purposes. U.S. sorghum production is second only to corn as a feed crop. Feed use rose from 412 million bushels in 1964 to 701 million bushels in 1973, and then dropped to 473 million bushels in 1977. It accounted for 73 percent of U.S. sorghum production in 1978. Another 26 percent was exported, accounting for 50 percent of world sorghum exports.

This report describes the U.S. sorghum industry from producer to consumer and provides a source of economic and statistical information on the U.S. sorghum subsector.

## BRIEF HISTORY OF SORGHUM 1/

Sorghum culture probably originated in eastern Africa (Ethiopia or Sudan) between 5,000 and 7,000 years ago. Migrating natives apparently carried sorghum to other African countries before the grain's existence was recorded.

The earliest record of sorghum is in a carving in the plain of Sennacherib, at Ninevah, Assyria, dated about 700 B.C. The grain reached Europe and India by about the beginning of the Christian era, the Botswana area by the 10th century A.D., China and southern Asia by the 13th century, Zambia by the 14th century, and southern Africa by the 16th century. Broomcorn sorghum, developed by repeated selection of sorghums with long panicle branches, also was cultivated in Europe by the 16th century. Benjamin Franklin is believed to have introduced it to North America in the latter part of the 18th century. Sorghum seed, carried by captive slaves, arrived in the Western Hemisphere during the 17th and 18th centuries. Varieties brought by those slaves were of minor importance, although one variety, Guinea corn, was grown well into the 20th century.

U.S. sorghum production for syrup and forage came after Chinese Amber sorghum was introduced from France in 1853 and 15 varieties of sorghum were brought from South

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1/ This section is based on the reports by Doggett (2) and Wall and Ross (60). (Underscored numerals refer to items in the References section.)

Africa in 1857 by Leonard Wray, an English sugar planter. Some of Wray's varieties gave rise to sweet sorghum varieties such as Orange, White African, and Honey, still popular today. Sorghum has been a prominent crop in the southern half of the U.S. Great Plains since the latter half of the 19th century. Sudangrass, a major forage crop in this country, was brought from the Sudan by U.S. Department of Agriculture personnel in 1909.

Plant breeders still explore Africa and Asia in search of desirable plant and grain characteristics to incorporate into hybrids. The United States introduced varieties to Argentina, Paraguay, and Australia during the 20th century, helping those countries produce sorghum on a large scale. Sorghum resists drought and heat better than other feed grains, provides grain and forage for livestock, and furnishes cash income for farmers in the southern half of the Great Plains. Broomcorn sorghum was a leading cash income crop for the farmers in that region in the early 1900's to 1940's. Towns were named after various sorghum groups because of the grain's importance to the early settlers: Feterita, Kans.; Milo and Mocan, Okla.; and Kafir and Sudan, Tex.

U.S. sorghum production increased more than eightfold between 1940 and 1975. Acreage more than doubled and average yields tripled. Combine harvesting, multiple row planting equipment, and better tillage and cultivation machinery permitted increased acres devoted to sorghum as a cash crop, with a minimum of manual labor.

The response of sorghum to ample soil moisture and high soil nitrogen levels has resulted in increased irrigated sorghum acreage and extensive use of commercial fertilizers. These practices, along with the development of improved hybrids, better pest control, more optimal plant population, and better cultural operations are largely responsible for the dramatic yield increases.

## SUPPLY

The United States is the world's largest sorghum producer, accounting for more than one-fourth of total world production since 1960. Annual U.S. sorghum supply available for domestic use and export consists primarily of production and stocks (table 1). Imports have been small and do not significantly affect domestic supply and disappearance in the U.S. sorghum subsector (imports are listed in table 11). Most sorghum is harvested between July and October, with approximately 75 percent of the crop marketed between July and January.

### Location and Production Trends

Sorghum is produced under a wide range of soil and climatic conditions. It withstands limited moisture conditions and adapts to high temperatures. Most is produced in the Southern Plains States, with about 80 percent of the harvest taking place in Texas, Kansas, and Nebraska.

There have been noticeable changes in production locations since 1950, although they have been relatively small in most cases. The most noticeable shifts occurred in the aggregate share of Kansas, Nebraska, Oklahoma, and Texas, which dropped from 90.4 percent in 1950 to a low of 78.5 percent in 1971 (table 2). The average aggregate production share from 1970 to 1979 was 82.8 percent. Relative rankings among the major sorghum producing States were quite stable until 1976, with Texas, Kansas, Nebraska, Oklahoma, and California the first five major States. Missouri sorghum production exceeded Oklahoma and California production during 1976-78.

Although a major producer of the total domestic crop, Texas' relative share in production has declined since 1950. Increases in other States, primarily Kansas and

Table 1--Supply and distribution of sorghum, United States

Year beginning October 1	Supply			Distribution				
	Oct. 1 stocks <u>1/</u>	Production	Total	Seed <u>2/</u>	Industrial and food uses <u>3/</u>	Exports <u>4/</u>	Feed and residual <u>5/</u>	Total
Million bushels								
1950	60	234	293	2	36	75	141	255
1951	38	163	201	2	12	62	115	191
1952	10	91	101	2	4	10	77	93
1953	7	115	123	2	5	15	78	101
1954	22	236	258	3	8	48	124	182
1955	75	243	318	3	8	66	159	236
1956	81	205	286	3	9	22	172	206
1957	79	568	646	3	9	57	269	337
1958	309	581	890	2	9	100	269	380
1959	510	555	1,065	2	12	98	371	483
1960	581	620	1,201	2	11	71	416	499
1961	702	480	1,182	2	12	99	408	520
1962	661	510	1,171	2	10	113	391	516
1963	655	585	1,240	2	11	107	471	591
1964	649	490	1,139	2	11	148	412	573
1965	566	673	1,239	2	11	266	569	848
1966	391	715	1,106	2	11	248	601	862
1967	244	755	999	2	11	166	532	711
1968	288	731	1,019	2	11	106	613	732
1969	287	730	1,017	2	7	126	638	773
1970	244	684	928	3	7	144	684	838
1971	90	876	966	2	7	123	692	824
1972	142	809	951	2	4	212	660	878
1973	73	930	1,003	2	4	234	701	942
1974	61	623	684	2	4	212	431	649
1975	35	753	788	2	4	229	502	737
1976	51	720	771	2	4	246	428	680
1977	91	793	884	2	5	213	473	693
1978	191	748	939	2	5	200	573	780
1979	159	814	974	2	5	275	561	843

1/ Includes all old crop grain in all storage positions.

2/ Based on acreage seeded to the following crop.

3/ Principally alcohol and distilled spirits. Includes an allowance for wet processing.

4/ Grain only.

5/ Includes other minor uses and waste.

Source: (29).

Year beginning October 1	Kansas	Nebraska	Oklahoma	Texas	Aggregate share
			<u>Percent</u>		
1950	19.0	2.0	7.5	61.9	90.4
1951	35.8	1.0	10.5	45.1	92.4
1952	22.3	2.7	5.1	58.1	88.2
1953	28.0	2.7	7.0	50.5	88.2
1954	22.0	6.2	2.7	57.6	88.5
1955	13.7	3.3	5.9	61.2	84.1
1956	11.8	6.0	3.0	60.2	81.0
1957	22.9	13.7	2.7	42.2	81.5
1958	21.1	12.8	3.0	44.7	81.6
1959	24.2	10.5	3.2	47.4	85.3
1960	27.1	14.6	3.8	41.7	87.2
1961	23.3	12.5	3.5	47.9	87.2
1962	25.3	19.9	3.9	39.5	88.6
1963	25.1	17.9	3.7	41.7	88.4
1964	20.0	19.3	3.0	43.9	86.2
1965	20.5	19.1	3.4	42.9	85.9
1966	19.5	19.9	2.9	43.6	85.9
1967	19.5	17.1	3.4	44.9	84.9
1968	22.1	13.8	3.5	46.0	85.4
1969	24.5	15.9	3.4	41.5	85.3
1970	21.3	11.0	3.4	48.1	83.8
1971	26.7	14.1	3.1	34.6	78.5
1972	26.8	14.6	3.3	39.5	84.2
1973	23.3	15.0	3.3	44.5	86.1
1974	21.1	10.0	3.6	49.6	84.3
1975	20.0	13.6	3.3	49.4	86.3
1976	23.6	16.6	2.4	40.7	83.3
1977	30.6	18.5	2.7	29.1	80.9
1978	27.9	18.3	2.3	30.4	78.9
1979	31.5	17.8	2.8	29.8	81.9
Average	23.3	12.7	3.8	45.3	85.1

Source: (29).

Nebraska, occurred at a faster rate than in Texas. The Texas share averaged 45.3 percent from 1950 to 1979.

Texas production has ranged from 54 million bushels in 1952 to 417 million bushels in 1973 (table 3). Kansas sorghum production increased sharply from 19 million bushels in 1952 to 243 million bushels in 1977 (table 4). The increase in Nebraska sorghum production was similar to Kansas (table 5). Oklahoma, the fourth largest sorghum producing State, did not increase sorghum production as rapidly as the other three major States (table 6).

U.S. sorghum production has fluctuated dramatically. Production increased sharply in the fifties; acreage declines were offset by increased yields in the sixties; and considerable variation prevailed in total sorghum production in the seventies (table 7). The wide fluctuation in production resulted primarily from adverse weather, along with changing Government policies, unstable prices, and changing market and price expectations. U.S. sorghum production more than tripled from 1950-54 to 1975-79. Acreage increases accounted for slightly over one-third of this production increase, while yield increases accounted for slightly under two-thirds of the production rise.

Sorghum also is harvested for forage and silage (table 7). Production for both forage and silage initially increased in the early fifties. The combined harvested acreage of forage and silage peaked in 1955, with a gradual decline in importance since that date. The U.S. Department of Agriculture discontinued production estimates for forage in 1969 (table 7). For these reasons, the remaining portion of this report will deal with sorghum as a grain.

### Area

Total U.S. sorghum acreage led barley, durum wheat, other spring wheat, rye, rice, and cotton between 1970 and 1979 (table 8). Corn, winter wheat, soybeans, and hay acreage exceeded that of sorghum. Oats and sorghum acreages alternated in relative size: sorghum averaged 17.8 million acres and oats averaged 18.6 million acres. U.S. sorghum acreage rose sharply from 5.3 million acres in 1952 to 19.7 million acres in 1957. Acreage variation was less during the sixties and seventies, with a range of 11 to 16 million. Acreage rose nearly 70 percent between 1950-54 and 1975-79.

Acreage planted to sorghum in the major sorghum producing States is inversely related to trends in the acreage of other crops (fig. 1). Sorghum acreage increased sharply during the fifties, while wheat, cotton, and corn acreage in the same States declined. When sorghum acreage declined in the early sixties, wheat, cotton, and corn acreage in the major sorghum States rose. Winter wheat, corn, and cotton are the most important competitors of sorghum in Texas. Cotton is the competitor in California and Oklahoma. Corn and soybean substitution is of particular importance in parts of Kansas and Nebraska.

Texas acreage increased 25 percent between 1950-54 and 1975-79, while Kansas and Nebraska acreage rose 33 percent and 758 percent, respectively. Sorghum acreage in Oklahoma declined 28 percent during the same period.

### Yields

Increased yields were largely responsible for the rise in sorghum production during 1950-72. U.S. sorghum yields surged steadily upward with the introduction of hybrids in 1956; yields tripled the prehybrid level by 1972. A record U.S. yield of 60.7 bushels per acre was reached in 1972. Yields leveled off after 1973 and declined to an average of 45.1 bushels in 1974, the lowest since 1964. The average yield recovered to 56.3 bushels by 1977 and reached a record level of 62.9 bushels by 1979.



Table 3--Texas sorghum: Acreage, yield, and production

Year beginning October 1	Harvested acres	Yield	Production
	<u>1,000 acres</u>	<u>Bushels</u>	<u>1,000 bushels</u>
1950	6,289	23.0	144,566
1951	3,913	19.0	74,193
1952	2,860	19.0	54,264
1953	2,766	20.5	56,837
1954	5,782	23.5	135,630
1955	6,316	23.5	148,309
1956	4,777	26.0	124,202
1957	7,510	32.5	244,075
1958	7,619	33.0	251,427
1959	7,162	36.0	257,832
1960	6,804	38.0	258,552
1961	5,103	45.0	229,635
1962	5,154	39.0	201,006
1963	5,515	44.0	242,660
1964	4,688	46.0	215,648
1965	5,251	56.0	294,056
1966	5,566	56.0	311,696
1967	6,735	51.0	343,485
1968	6,196	55.0	340,780
1969	6,196	50.0	309,800
1970	5,886	56.0	329,616
1971	5,827	52.0	303,004
1972	5,420	59.0	319,780
1973	6,950	60.0	417,000
1974	6,000	52.0	312,000
1975	7,200	52.0	374,400
1976	5,800	50.5	292,900
1977	4,800	48.0	230,400
1978	4,650	49.0	227,850
1979	4,500	54.0	243,000

Source: (29).

Table 4--Kansas sorghum: Acreage, yield  
and production

Year beginning October 1	Harvested acres	Yield	Production
	<u>1,000 acres</u>	<u>Bushels</u>	<u>1,000 bushels</u>
1950	1,943	23.0	44,689
1951	2,605	22.0	57,310
1952	1,324	14.0	18,536
1953	1,915	16.0	30,640
1954	3,567	14.5	51,722
1955	2,891	11.5	33,246
1956	1,626	15.0	24,390
1957	6,149	21.0	129,129
1958	3,908		128,964
1959	4,053	35.0	141,855
1960	4,296	39.0	167,544
1961	2,792	40.0	111,685
1962	2,960	43.5	128,760
1963	3,789	39.0	147,771
1964	3,069	32.0	98,208
1965	3,031	36.0	139,426
1966	2,849	49.0	139,601
1967	3,248	46.0	149,408
1968	3,475	47.0	163,325
1969	3,266	56.0	182,896
1970	3,560	41.0	145,960
1971	4,325	54.0	233,550
1972	3,500	62.0	217,000
1973	3,900	56.0	218,400
1974	3,320	62.0	217,000
1975	3,430	42.0	144,060
1976	3,950	43.0	169,850
1977	4,050	60.0	243,000
1978	4,020	52.0	209,040
1979	3,720	69.0	256,680

Source: (29).

Table 5--Nebraska sorghum: Acreage, yield, and production

Year beginning October 1	Harvested acres	Yield	Production
	<u>1,000 acres</u>	<u>Bushels</u>	<u>1,000 bushels</u>
1950	194	25.0	4,850
1951	128	13.0	1,664
1952	97	23.0	2,231
1953	182	16.0	2,912
1954	540	27.0	14,580
1955	720	11.0	7,920
1956	889	14.0	12,446
1957	1,983	39.0	77,337
1958	1,624	48.0	77,952
1959	1,413	43.5	61,683
1960	1,796	50.5	90,698
1961	1,185	50.5	59,842
1962	1,540	66.0	101,640
1963	1,910	55.0	105,050
1964	2,025	47.0	95,175
1965	2,271	53.5	121,498
1966	2,089	68.0	95,259
1967	2,193	56.5	123,904
1968	1,754	58.0	101,732
1969	1,561	76.0	118,636
1970	1,520	51.0	77,720
1971	2,057	60.0	123,420
1972	1,640	72.0	118,080
1973	2,000	68.0	136,000
1974	1,900	33.0	62,700
1975	1,900	55.0	104,500
1976	2,100	57.0	119,700
1977	2,130	71.0	151,230
1978	1,830	75.0	137,250
1979	1,830	79.0	144,570

Source: (29).

Table 6---Oklahoma sorghum: Acreage, yield, and production

Year beginning October 1	Harvested acres	Yield	Production
	<u>1,000 acres</u>	<u>Bushels</u>	<u>1,000 bushels</u>
1950	947	18.5	17,520
1951	1,048	16.0	16,768
1952	472	9.0	4,248
1953	613	12.5	7,662
1954	614	10.5	6,447
1955	1,108	13.0	14,404
1956	587	10.5	6,447
1957	922	16.5	15,213
1958	710	26.0	18,460
1959	696	27.0	18,792
1960	779	30.5	23,760
1961	553	30.5	16,866
1962	658	30.0	19,740
1963	740	29.5	21,830
1964	577	25.5	14,714
1965	590	37.0	21,830
1966	507	40.0	20,280
1967	679	38.0	25,802
1968	638	38.0	26,158
1969	542	47.0	25,474
1970	542	43.0	23,306
1971	750	36.0	27,000
1972	630	43.0	27,090
1973	696	44.0	30,624
1974	600	38.0	22,800
1975	520	38.0	19,760
1976	565	30.0	16,950
1977	565	38.0	21,470
1978	485	36.0	17,460
1979	515	45.0	23,175

Source: (29).

Table 7--United States: Acreage, yield, production, and value of sorghum grain, forage, and silage

Year beginning October 1	Acreage planted for all purposes	Grain				
		Acreage harvested	Yield per harvested acre	Production	Price per bushel <u>1/</u>	Farm value
	<u>1,000</u> <u>acres</u>		<u>Bushels</u>	<u>1,000</u> <u>bushels</u>	<u>Dollars</u>	<u>1,000</u> <u>dollars</u>
1950	16,055	10,346	22.6	233,536	1.05	245,342
1951	15,028	8,544	19.1	162,863	1.32	215,468
1952	12,289	5,326	17.0	90,741	1.58	142,221
1953	14,590	6,295	18.4	115,719	1.32	152,036
1954	20,148	11,718	20.1	235,575	1.26	296,063
1955	23,921	12,891	18.8	242,638	.98	238,005
1956	21,384	9,209	22.2	204,881	1.15	236,024
1957	26,682	19,682	28.8	567,506	.97	550,599
1958	20,675	16,524	35.2	581,012	1.00	579,635
1959	19,508	15,406	36.1	555,441	.86	472,078
1960	19,598	15,601	39.7	619,954	.84	514,886
1961	14,294	10,985	43.7	480,208	1.01	483,067
1962	15,060	11,571	44.1	510,284	1.02	516,518
1963	17,516	13,326	43.9	585,394	.98	567,785
1964	16,770	11,742	41.7	489,796	1.05	511,988
1965	17,079	13,029	51.6	672,698	1.00	667,967
1966	16,346	12,837	55.8	714,944	1.03	738,944
1967	18,945	14,988	50.4	755,344	.99	744,162
1968	17,793	13,890	52.6	731,277	.95	690,608
1969	17,231	13,437	54.3	729,919	1.07	771,510
1970	16,957	13,568	50.4	683,179	1.14	779,630
1971	20,547	16,142	53.8	867,997	1.04	895,823
1972	17,035	13,212	60.7	801,350	1.37	1,096,062
1973	18,994	15,700	58.8	923,224	2.14	1,978,268
1974	17,588	13,809	45.1	622,711	2.77	1,721,927
1975	18,104	15,355	49.0	753,046	2.37	1,775,023
1976	18,402	14,723	48.9	719,817	2.03	1,450,085
1977	16,993	14,092	56.3	792,983	1.82	1,433,991
1978	16,468	13,561	55.1	747,790	2.02	1,501,737
1979	15,399	12,949	62.9	814,308	2.31	1,866, 25

See footnotes at end of table.

Continued



Table 7--United States: Acreage, yield, production, and value of sorghum grain, forage, and silage--Continued

Year beginning October 1	Forage					Silage		
	Acreage harvested	Yield per harvested acre	Production	Price per ton	Farm value	Acreage harvested	Yield per harvested acre	Production
	1,000 acres	Tons		Dollars	1,000 dollars	1,000 acres	Tons	1,000 tons
1950	4,304	1.53	6,567	13.40	87,893	706	7.33	5,176
1951	4,550	1.33	6,072	19.70	119,345	855	6.85	5,858
1952	4,578	.89	4,069	24.90	101,444	794	5.31	4,218
1953	4,814	1.15	5,535	15.90	88,231	1,083	6.01	6,506
1954	5,053	1.02	5,172	17.70	91,626	1,359	5.59	7,603
1955	6,142	1.09	6,725	15.60	104,825	1,758	5.49	9,643
1956	6,136	.73	4,457	20.40	90,964	1,463	6.28	9,194
1957	3,991	1.69	6,729	12.50	84,070	1,989	8.33	16,560
1958	2,118	1.99	4,209	10.70	45,132	1,418	9.28	13,155
1959	2,265	1.69	3,835	15.30	58,837	1,347	8.60	11,640
1960	2,163	1.79	3,861	15.70	60,623	1,386	9.10	12,618
1961	1,701	1.99	3,384	15.40	52,259	1,305	10.00	13,005
1962	1,960	2.04	3,991	14.40	57,280	1,227	10.50	12,907
1963	2,365	1.82	4,299	16.90	72,709	1,273	10.10	12,826
1964	2,809	1.48	4,147	17.90	74,241	1,200	9.40	11,249
1965	2,376	1.87	4,451	14.80	65,677	1,195	10.30	12,324
1966	2,064	2.07	4,273	15.90	67,728	1,089	10.90	11,851
1967	2,327	1.75	4,080	16.80	68,345	1,036	9.90	10,236
1968	2,504	2.04	5,116	17.30	88,564	908	10.70	9,749
1969	2,600	--	--	--	--	798	11.70	9,360
1970	2,167	--	--	--	--	741	9.70	7,206
1971	2,675	--	--	--	--	1,011	10.90	10,968
1972	2,427	--	--	--	--	840	11.80	9,946
1973	2,093	--	--	--	--	836	11.40	9,520
1974	2,140	--	--	--	--	745	9.80	7,279
1975	1,568	--	--	--	--	752	9.90	7,426
1976	1,883	--	--	--	--	772	9.30	7,168
1977	1,633	--	--	--	--	842	10.90	9,168
1978	1,577	--	--	--	--	715	10.90	7,768
1979 <sup>2/</sup>	1,266	--	--	--	--	767	11.70	9,011

-- = Not available.

<sup>1/</sup> Does not include Government payments per bushel.<sup>2/</sup> Preliminary.

Source: (29).

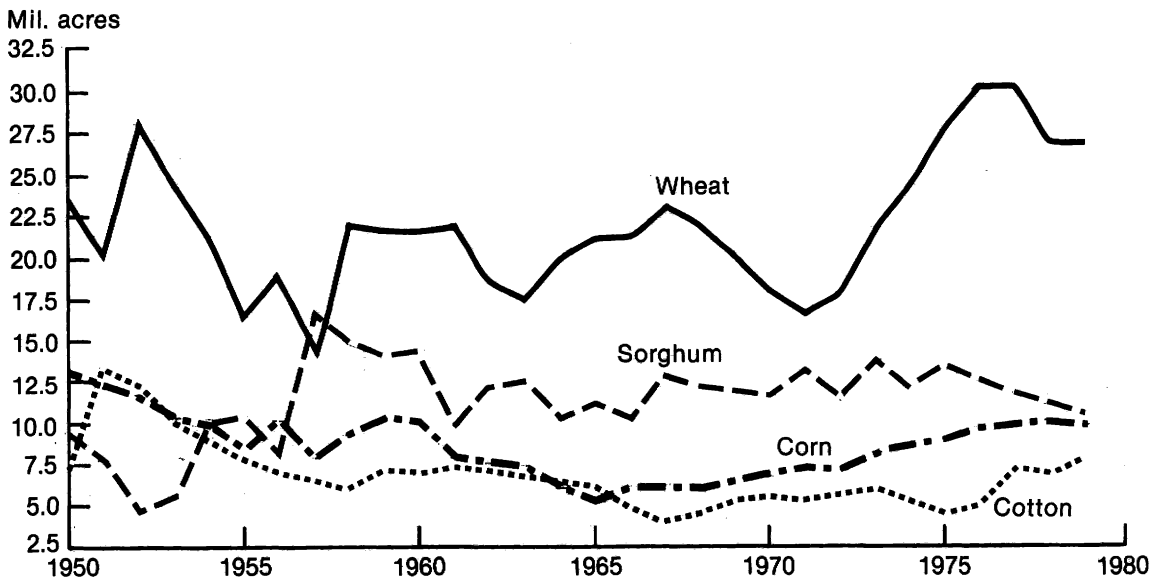
Table 8--Area planted to major U.S. field crops

Crop	Crop year beginning October 1									
	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979
	<u>Million acres</u>									
Feed grains:										
Corn	66.8	74.1	67.0	71.9	77.8	77.9	84.4	83.6	80.1	80.0
Sorghum	17.0	20.8	17.3	19.2	17.7	18.3	18.4	17.0	16.5	15.4
Oats <u>1/</u>	24.5	22.0	20.2	19.1	18.0	17.4	16.7	17.7	16.2	14.1
Barley <u>1/</u>	10.5	11.1	10.6	11.2	9.0	9.5	9.2	10.6	10.0	8.1
Total feed	118.8	128.0	115.1	121.4	122.5	123.1	128.7	128.9	122.8	117.6
Food grains:										
Wheat	48.7	53.8	54.9	59.0	71.4	75.1	80.2	75.1	66.3	71.6
Winter <u>2/</u>	37.6	38.1	42.2	43.2	52.4	56.2	57.7	56.3	47.9	51.9
Durum	2.2	2.9	2.6	3.0	4.2	4.8	4.7	3.2	4.1	4.0
Other	8.9									
spring	8.9	12.8	10.1	12.8	14.8	14.1	17.8	15.6	14.3	15.6
Rye	4.2	4.8	3.5	3.5	3.2	3.2	2.7	2.7	3.0	3.1
Rice	1.8	1.8	1.8	2.2	2.6	2.8	2.5	2.3	3.0	3.0
Total food	54.7	60.4	60.2	64.7	77.2	81.1	85.4	80.1	72.5	77.6
Other crops:										
Soybeans	43.1	43.5	46.9	56.7	53.5	54.6	50.2	58.8	64.4	71.6
Cotton	11.9	12.4	14.0	12.5	13.7	9.7	11.7	13.7	13.4	14.0
Hay <u>3/</u>	61.5	61.5	59.7	61.8	60.2	61.3	60.3	60.7	61.5	61.2
Total	116.5	117.3	120.7	131.3	127.8	126.2	122.2	133.2	139.3	146.8
Total crops	290.0	305.7	296.0	317.4	327.5	330.4	336.3	342.2	335.0	345.7

1/ Includes area planted in preceding fall.2/ Area planted in preceding fall.3/ Harvested acres.

Source: (40).

Figure 1

**Sorghum for Grain, Wheat, Corn for Grain, and Cotton Acreage Planted, 1950-78**

Wheat, sorghum, and corn acreage in Kansas, Nebraska, Oklahoma and Texas. Cotton acreage in Oklahoma and Texas.  
Source: (29).

Yields in the four major producing States followed a pattern of change similar to U.S. yields. Average yield per acre in 1975-79 ranged from 37.4 bushels in Oklahoma to 67.4 bushels in Nebraska. Per acre yields during this same period averaged 50.7 bushels in Texas and 53.2 bushels in Kansas.

A slowdown in sorghum yield response is apparent in the 5-year averages reported in table 9. Rice, wheat, oats, and barley yield data indicate the same tendency. Corn is an exception, with yields continuing upward, partially because of a continuing shift to a greater irrigated acreage. Several factors could be contributing to this phenomenon in sorghum. Yields were relatively low in the period prior to hybrids. Producers rapidly adopted the new hybrids and accompanying technology in the late fifties and early sixties causing a sharp rise in average yields. New technology in the late sixties and seventies was less spectacular in its effect on yields than were the first hybrids. Another factor contributing to apparent leveling off in yields is the shift of irrigated sorghum acres in Texas to corn, increasing the percentage of sorghum production on dryland. Irrigated sorghum acres declined from about one-third of the harvested acreage in Texas in the early seventies to about one-fifth in the late seventies. Texas irrigated sorghum yields followed a pattern similar to average U.S. sorghum yields, indicating other factors also affected yields. In the seventies, during low grain prices and sharply rising costs, producers were more concerned about minimizing losses than maximizing yields. Therefore, use of inputs such as water and fertilizer may have been reduced. Also, as a result of the all-out grain production of the mid-seventies, more marginal land was brought back into production.

Table 9--Average per acre yields of U.S. grains

Year	Rice	Wheat	Corn	Oats	Barley	Sorghum
	<u>Pounds</u>			<u>Bushels</u>		
1950-54	2,411	17.3	39.4	33.9	27.8	19.4
1955-59	3,192	22.2	48.7	38.7	29.5	28.2
1960-64	3,725	25.2	62.5	43.9	33.8	42.6
1965-69	4,371	27.5	78.5	50.4	42.0	52.9
1970-74	4,550	31.3	84.1	50.4	42.1	53.7
1975-79	4,541	31.5	95.0	51.4	46.4	54.4

Source: (29).

New sorghum hybrids released in the late seventies can produce a high, stable yield at the lower latitudes under conditions of high night temperatures, short day lengths, high humidity, and high disease incidence common to southern sorghum producing areas (15). These hybrids offer at least a 20-percent potential increase in yields for south and central Texas, the mid-South, and the Southeast which have been plagued with lower yields.

### Stocks

The carryover of old crop stocks into the new marketing year represents a net addition to supply available for use during the year. Stocks data are collected periodically and reported by the U.S. Department of Agriculture on January 1, April 1, June 1, and October 1. The intervening time periods are called intramarketing year periods, rather than quarters, because one period (April-May) consists of only 2 months, and another (June-September) consists of 4 months.

Seasonal inventories of sorghum in all positions from 1950 through 1979 are shown in table 10. Stocks in mills, elevators, warehouses, and terminal markets surpassed those held on the farms. Stocks held by the Commodity Credit Corporation (CCC) were significant relative to total stocks during the late fifties and early sixties (tables 10 and 49). On-farm stocks have fluctuated, with no consistent trend up or down.

October 1 carryover stocks generally increased from 1953 until 1961, reaching a peak of 702 million bushels (table 11). They decreased to 244 million bushels in 1970, then declined to 91 million bushels in 1971, the lowest since 1957. Stocks rose in 1972, steadily dropped to a low of 35 million bushels in 1975, and increased to 191 million bushels in 1978. The 1979 carryover was about one-fifth of the U.S. supply. Carryover stocks represent excess supplies from the previous year as well as working inventories. Stocks are highest in January after the harvest.

Table 10--Stocks of U.S. sorghum on and off farms

Year beginning October 1	On farms				Off farms			
	Jan. 1	Apr. 1	July 1 <u>1/</u>	Oct. 1	Jan. 1	Apr. 1	July 1 <u>1/</u>	Oct. 1
	<u>1,000 bushels</u>							
1950	60,555	--	--	4,962	67,600	70,815	69,132	54,743
1951	78,412	--	--	7,823	131,828	94,983	59,609	30,282
1952	53,385	--	--	5,882	96,462	49,326	11,717	4,132
1953	25,358	--	--	3,594	30,282	18,550	7,574	3,902
1954	38,559	--	--	3,418	42,915	37,528	31,570	18,842
1955	59,979	--	--	6,317	138,018	120,645	93,123	68,674
1956	71,938	--	14,138	5,574	154,636	126,571	103,678	75,823
1957	58,599	26,866	8,558	3,358	145,497	111,933	90,407	76,069
1958	206,166	96,934	28,105	13,445	311,161	327,642	314,780	295,986
1959	183,917	97,447	33,073	18,507	528,191	511,022	494,522	491,155
1960	186,525	107,112	44,211	22,726	683,152	636,909	591,952	558,495
1961	216,907	108,983	54,390	32,414	815,483	750,808	699,580	669,515
1962	148,825	83,538	41,585	24,241	889,686	767,816	704,363	636,729
1963	177,636	101,716	50,667	34,815	846,514	725,258	643,767	619,811
1964	189,625	110,128	63,091	42,347	833,074	730,349	651,776	606,453
1965	154,259	98,010	61,565	47,442	797,589	669,893	595,677	518,093
1966	212,919	133,589	71,353	50,614	765,142	590,556	461,521	340,587
1967	234,170	133,178	81,981	44,414	586,872	393,312	253,553	199,486
1968	212,743	141,921	90,536	58,063	519,341	374,907	277,408	230,948
1969	217,904	127,380	81,996	51,913	413,366	413,366	302,491	235,040
1970	184,644	117,505	67,649	38,726	503,506	385,895	278,918	205,235
1971	151,511	87,822	35,555	13,332	459,066	268,081	141,300	77,140
1972	243,431	142,402	66,585	30,514	463,528	336,362	208,488	111,231
1973	217,572	94,724	45,338	13,658	401,830	267,714	153,996	59,003
1974	217,090	113,602	54,576	18,086	426,818	266,742	123,533	43,145
1975	121,941	63,193	29,778	7,849	257,843	145,278	65,307	27,188
1976	163,935	83,728	49,622	13,927	309,600	164,221	104,090	37,486
1977	160,875	88,362	61,327	21,644	331,631	208,250	135,182	69,646
1978	220,851	140,863	109,325	56,366	398,245	273,525	210,749	134,477
1979	239,396	142,512	100,221	40,757	401,484	276,684	222,988	118,683
1980	233,956	--	--	--	411,968	--	--	--

-- = Not available.

1/ Stocks estimated on June 1 beginning 1976.

Source: (45).



Table 11--Carryover, production, imports, and total U.S. supply of sorghum

Year beginning October 1	Carryover, October 1			Production	Imports	Total supply
	On farm	Terminal markets, mills, elevators, and warehouses	Total			
Million bushels						
1950	5.0	54.7	59.7	233.5	--	293.2
1951	7.8	30.3	38.1	162.9	--	201.0
1952	5.9	4.1	10.1	90.7	--	100.7
1953	3.6	3.9	9.5	115.7	--	123.2
1954	3.4	18.8	22.3	235.6	--	257.8
1955	6.3	68.7	75.0	242.6	--	317.6
1956	5.6	75.8	81.4	204.9	--	286.3
1957	3.4	76.1	79.4	567.5	--	646.9
1958	13.4	296.0	309.4	581.0	--	890.4
1959	18.5	491.2	509.7	555.4	--	1,065.1
1960	22.7	558.5	581.2	620.0	--	1,201.2
1961	32.4	669.5	701.9	480.2	--	1,182.1
1962	24.2	636.7	661.0	510.3	--	1,171.3
1963	34.8	619.8	654.6	585.4	0.06	1,240.1
1964	42.3	606.5	648.8	489.8	.01	1,138.6
1965	47.4	518.1	565.5	672.7	.01	1,238.2
1966	50.6	340.6	391.2	715.0	.08	1,106.3
1967	44.4	199.5	243.9	755.3	.07	999.3
1968	58.1	230.9	289.0	731.3	.06	1,020.3
1969	51.9	235.0	287.0	729.9	.04	1,016.9
1970	38.7	205.2	244.0	683.2	0	927.1
1971	13.3	77.1	90.5	868.0	.01	958.5
1972	30.5	111.2	141.7	801.4	.02	943.1
1973	13.7	59.0	72.7	923.2	.01	995.9
1974	18.1	43.1	61.2	622.7	.01	684.0
1975	7.8	27.2	35.0	753.0	0	788.1
1976	13.9	37.5	51.4	719.8	0	771.2
1977	21.6	69.6	91.2	793.0	.01	884.2
1978	56.4	134.5	190.9	747.8	0	938.7
1979	40.8	118.7	159.5	814.3	0	973.8

-- = Not available.

Source: (29).

## Total Supply

The U.S. supply of sorghum, consisting primarily of October 1 carryover and production, was relatively low during the early fifties (table 11). Production, spurred by introduction of hybrids in 1956, increased much faster than demand, resulting in a rapid buildup of stocks. Thus, increased production and the rapid buildup of stocks multiplied supplies more than 12 times by 1963 over the 100.7 million bushels available in 1952.

Increased demand surpassed production by the midsixties and started a downtrend in carryover stocks. The drop in world grain production in the midsixties helped to reduce the U.S. sorghum carryover as exports rose to cover world demand. Production continued upward until 1973, peaked at 923 million bushels, and has since leveled at about 800 million bushels. Demand also leveled off in the midseventies, but the total supply in 1979 was 91 million bushels below that of 1959 and 266 million bushels below the 1963 peak.

## DISTRIBUTION

Sorghum is mostly used as a feed grain in the United States (table 1). Almost three-fourths of U.S. sorghum production in 1935-39 was used as feed and seed on the farms where it was produced. U.S. sorghum feed is now used commercially and nearly one-third of the crop is exported.

## Feed Use

Feed use accounted for about 75 percent of the U.S. disappearance from 1950 to 1979, ranging from a low of 55 percent in 1950 to a high of 84 percent in 1968 and 1970. Seed use ranged from 0.2 to 2.2 percent of total disappearance during the same period. Sorghum used in industry and for food ranged from a low of 0.4 percent in 1973 to a high of 14.1 percent in 1950. Except for a large share of disappearance in the early fifties, industrial and food use was below 3 percent of total disappearance after 1956. Five-year average distribution patterns are presented in table 12.

Total domestic use increased from an average of 164 million bushels during 1950-54 to an average of 827 million bushels during 1970-74, an increase of 663 million bushels (table 1). Sorghum feed use increased during the same period from an average of 107 million bushels to 635 million bushels. That increase of 528 million bushels accounted for 80 percent of sorghum's increase in total distribution.

The sorghum belt (Texas and Oklahoma Panhandle, western Kansas, and Nebraska) offered the cattle feeding industry a source of feed grain and a favorable operating climate. Therefore, growth in the commercial sorghum feed industry coincided with increases in the feedlot industry in Texas and the Southern Plains. Kansas, Nebraska, and Oklahoma producers use a higher proportion of sorghum on the farm where it is produced. The proportion of sorghum used on sorghum producing farms during 1960-64 varied from 7.5 percent in Texas to 40 percent in Kansas, 32 percent in Nebraska, and 45.8 percent in Oklahoma (table 13). The national average was 23.9 percent of total U.S. production in the early sixties. The proportion of sorghum used on sorghum producing farms declined in the four major States and the United States from 1950-54 to 1974-79. However, a reversal of this trend occurred during 1975-78.

Fed cattle marketed account for much of the increase in consumption of all feed and concentrates. Fed cattle marketed increased at an average annual rate of about 9 percent from 1955 to 1972 in the 23 major cattle feeding States. Texas fed cattle marketed increased from 227,000 head in 1955 to 4.3 million head in 1972; Kansas from

Table 12--Trends in sorghum use as a percentage of total distribution 1/

Year	Seed	Industrial and food uses	Exports	Feed and residual
<u>Percent</u>				
1950-1954	1.3	7.9	25.6	65.2
1955-1959	.8	2.8	20.9	75.5
1960-1964	.4	2.0	19.9	77.7
1965-1969	.3	1.3	23.2	75.2
1970-1974	.3	.6	22.4	76.7
1975-1979	.3	.6	31.1	68.0

1/ Items may not add to 100 because of rounding errors.

Source: (29).

Table 13--Trends in U.S. sorghum use on farms where produced  
as a percentage of total production

Year	Texas	Kansas	Nebraska	Oklahoma	United States
<u>Percent</u>					
1950-1954	20.6	36.0	47.5	48.7	28.5
1955-1959	11.8	34.1	37.3	39.3	24.4
1960-1964	7.5	40.1	32.0	45.8	23.9
1965-1969	6.6	35.5	27.5	32.0	20.3
1970-1974	12.3	33.2	22.9	33.5	22.9
1975-1978	19.9	36.3	21.0	29.6	27.0

Source: (29).

498,000 head to 2.4 million head; and Nebraska from 1.3 million to 4.0 million head. Rising grain prices reversed this trend during 1973-75. However, fed cattle marketed resumed an upward trend after 1975.

Sorghum is second only to corn in concentrate feeds consumed by beef cattle (table 14). Sorghum made up 20.7 percent of the concentrate feed consumed by beef cattle in 1960. The relative share peaked at 26.6 percent in 1965 and gradually declined to 16.6 percent in 1976. Sorghum concentrates fed to dairy cattle, hogs, poultry, and other livestock are at a much lower relative share than those fed to beef cattle. However, the change in relative shares of sorghum concentrate consumed by each group from 1960 to 1979 follows a pattern similar to beef cattle. Corn is the dominant concentrate feed consumed.

Several broad forces in the U.S. economy have indirectly affected sorghum demand. People began to eat more meat and less starchy foods as per capita income improved after World War II. Red meat consumption rose from about 125 pounds per capita (retail weight) in the thirties to about 150 pounds in the sixties. It had declined to approximately 146 pounds in 1979. Per capita poultry consumption increased from about 30 pounds in the fifties to 62 pounds in 1979. Large increases in feed were required to keep up with the larger animal numbers needed in response to the growing population and per capita demand.

Table 15 shows the tendency toward more grain concentrate use in livestock rations as people began to demand more meat. Grain use relative to forage use has also increased since World War II, largely because of favorable feed-livestock price relationships.

Sorghum concentrate consumption by cattle on feed rose from 4.2 million to 13.1 million tons from 1950 to 1973. Consumption dropped to 6.3 million tons in 1974 when sorghum prices rose sharply. Sorghum faces competition from corn and other grains. Sorghum fed to all livestock averaged about 15 percent of the volume of corn and approximately 72 percent of that of other grains during the 1960-79 period.

Sorghum feed manufacturers and livestock feeders have become more willing to use sorghum as a feed in recent years after studies showed that sorghum was at least 95 percent as efficient as corn (table 16). Responses have been favorable toward sorghum feed use because it has been favorably priced relative to other feed grains. In recent years, it has been consistently priced below 95 percent of the value of corn (see table 33).

### Seed, Food, and Industrial Use

Sorghum for seed, food, and industrial use has declined to about 1 percent of total use since 1972 (table 1). Seed use, ranging from 2 to 3 million bushels annually, is directly related to area planted.

An average of 174 million pounds of sorghum were used in the fermentation process of the brewing industry for making distilled spirits during 1967-76 (table 17). Corn, rye, malt (barley), and wheat are also used. Sorghum and wheat use in the fermentation process has been increasing in relation to corn, rye, and malt (table 17). From a low 0.2 percent in 1953, sorghum use reached over 12 percent of the total grains used at distilleries in 1972 and 1975. Sorghum was at 9 percent of the total grains used in distilleries in 1977.

Sorghum dry milling is a small segment of the dry milling industry. The exact annual volume of sorghum dry milling is not estimated as a separate item in Government

(Continued on page 23)

Table 14--Consumption of harvested concentrate feeds,  
by kind of livestock

Year beginning October 1	Corn <u>1/</u>	Sorghum	Other grains <u>2/</u>	Other concentrates <u>3/</u>
<u>Percent of total</u>				
Beef cattle:				
1960	45.0	20.7	13.2	21.1
1961	42.6	21.1	11.7	24.6
1962	42.3	20.6	13.2	23.9
1963	43.1	21.5	10.2	25.2
1964	44.7	22.7	11.9	20.7
1965	43.4	26.6	12.1	17.9
1966	46.0	26.2	12.5	15.3
1967	49.6	22.6	14.4	13.4
1968	47.5	23.9	16.3	12.3
1969	47.6	21.5	18.8	12.1
1970	44.0	22.1	17.4	16.5
1971	47.9	22.3	18.2	11.9
1972	52.9	19.8	10.4	16.9
1973	56.3	20.1	7.5	16.1
1974	52.9	17.7	7.2	22.2
1975	53.7	20.2	6.4	19.7
1976	56.4	16.6	8.3	18.7
1977	60.8	17.5	5.4	16.3
1978	58.8	18.0	6.5	16.7
1979	57.5	21.6	6.0	14.9
Dairy cattle:				
1960	46.2	2.3	26.7	24.8
1961	48.0	2.6	25.3	24.1
1962	48.4	3.1	24.4	24.1
1963	47.6	3.6	23.8	25.0
1964	49.2	2.9	22.9	25.0
1965	53.4	4.5	18.8	23.3
1966	49.0	5.3	19.4	26.3
1967	53.1	4.2	19.6	23.1
1968	50.4	3.9	22.2	23.5
1969	52.3	4.4	19.9	23.4
1970	51.6	3.1	20.3	25.0
1971	53.3	3.3	18.9	24.5
1972	55.4	2.7	19.1	22.8
1973	55.7	2.8	19.9	21.6
1974	50.7	3.0	21.8	24.5
1975	50.3	3.2	19.7	26.3
1976	56.8	2.8	16.0	24.4
1977	59.3	2.9	14.9	22.9
1978	58.2	2.9	14.9	24.0
1979	59.1	3.5	16.4	21.0

See footnotes at end of table.

Continued



Table 14--Consumption of harvested concentrate feeds,  
by kind of livestock--Continued

Year beginning October 1	Corn <u>1/</u>	Sorghum	Other grains <u>2/</u>	Other concentrates <u>3/</u>
	<u>Percent of total</u>			
All livestock:				
1960	58.6	7.6	15.4	18.4
1961	60.0	7.5	13.7	18.8
1962	59.7	7.2	13.9	19.2
1963	57.8	8.7	13.6	19.9
1964	57.8	8.1	13.8	20.3
1965	59.1	9.7	12.4	18.8
1966	58.3	10.2	12.7	18.8
1967	60.5	8.9	12.2	18.4
1968	58.4	9.8	13.4	18.4
1969	58.6	9.6	13.6	18.2
1970	56.4	10.5	14.6	18.5
1971	58.8	10.0	14.1	17.1
1972	57.1	10.1	11.8	21.0
1973	57.8	10.3	10.9	21.0
1974	53.4	8.0	13.0	25.6
1975	53.8	9.7	10.5	26.0
1976	58.2	7.6	10.4	23.8
1977	60.1	7.9	8.5	23.5
1978	62.0	7.6	8.4	22.0
1979	61.6	8.8	8.4	21.2
Hogs:				
1960	78.1	1.5	11.0	9.4
1961	81.7	1.4	7.2	9.7
1962	82.6	1.3	6.8	9.3
1963	79.6	2.8	7.8	9.8
1964	79.9	2.4	7.7	10.0
1965	77.7	3.6	7.9	10.8
1966	79.6	3.1	7.2	10.1
1967	82.9	2.3	5.7	9.1
1968	81.2	2.6	5.6	10.6
1969	78.3	3.0	6.0	12.7
1970	77.8	3.0	8.3	10.9
1971	78.7	2.6	8.7	10.0
1972	76.2	3.3	3.7	16.8
1973	77.0	3.3	2.9	16.8
1974	72.1	3.5	3.9	20.5
1975	71.2	4.2	3.7	20.9
1976	74.9	3.4	4.0	17.7
1977	75.6	3.3	2.8	18.3
1978	76.5	3.0	2.4	18.1
1979	77.8	3.5	2.6	16.1

See footnotes at end of table.

Continued

Table 14--Consumption of harvested concentrate feeds,  
by kind of livestock--Continued

Year beginning October 1	Corn <u>1/</u>	Sorghum	Other grains <u>2/</u>	Other concentrates <u>3/</u>
	<u>Percent of total</u>			
Poultry:				
1960	44.9	8.6	15.7	30.8
1961	46.2	9.6	14.5	29.7
1962	47.0	9.0	12.3	31.7
1963	46.5	10.0	13.6	29.9
1964	48.8	8.1	13.9	29.2
1965	47.4	8.4	12.6	31.6
1966	50.3	9.8	12.3	27.6
1967	51.3	8.1	11.1	29.5
1968	51.5	8.2	11.6	28.7
1969	49.0	9.1	12.5	29.4
1970	50.6	8.7	12.3	28.4
1971	51.7	8.4	11.8	28.1
1972	48.3	6.2	12.1	33.4
1973	51.7	6.5	10.3	31.5
1974	46.4	6.2	13.0	34.4
1975	46.3	7.5	8.4	37.8
1976	50.5	6.1	10.0	33.4
1977	51.9	6.1	6.9	35.1
1978	53.2	5.8	6.3	34.7
1979	50.7	6.2	6.9	36.2
Other livestock:				
1960	51.2	3.5	24.4	20.9
1961	51.6	3.8	23.5	21.1
1962	51.9	3.8	22.0	22.3
1963	52.4	3.8	21.3	22.5
1964	52.9	3.9	21.1	22.1
1965	53.3	4.0	20.8	21.9
1966	50.2	3.6	19.8	26.4
1967	48.8	4.6	19.7	26.9
1968	50.0	4.1	18.8	27.1
1969	49.4	4.5	18.8	27.3
1970	49.0	3.6	19.0	28.4
1971	50.9	4.6	17.5	27.0
1972	18.6	4.4	42.5	34.5
1973	18.9	4.4	43.1	33.6
1974	18.1	4.0	45.0	32.9
1975	13.6	5.0	41.9	39.5
1976	17.2	5.3	36.1	41.4
1977	18.3	5.1	36.4	40.2
1978	39.6	4.3	31.6	24.5
1979	21.7	4.8	37.6	35.9

1/ Fats fed to livestock were converted to corn equivalent and added to corn.

2/ Includes oats, barley, wheat, and rye.

3/ Includes oilseed meals, animal proteins, grain proteins, wheat, and rice millfeeds, seeds, skim milk, hominy and other byproduct feeds plus estimates for urea, salt, and minerals.

Source: (49, 50).

Table 15--Feed units fed per animal unit, United States 1/

Year beginning October 1	Grain concentrates <u>2/</u>	Harvested roughage <u>3/</u>	Year beginning October 1	Grain concentrates <u>2/</u>	Harvested roughage <u>3/</u>
	<u>Tons</u>			<u>Tons</u>	
1952	1.71	0.74	1966	2.10	0.87
1953	1.76	.76	1967	2.13	.89
1954	1.72	.75	1968	2.22	.90
1955	1.78	.76	1969	2.35	.85
1956	1.80	.81	1970	2.25	.85
1957	1.96	.84	1971	2.17	.81
1958	2.04	.78	1972	2.22	.80
1959	1.98	.78	1973	2.18	.79
1960	2.03	.79	1974	1.94	.84
1961	2.03	.80	1975	2.02	.99
1962	1.96	.78	1976	1.98	1.02
1963	1.95	.79	1977	1.98	.96
1964	1.96	.80	1978	2.17	.98
1965	2.17	.85	1979	2.17	--

- = Not available.

1/ Concentrates per grain consuming animal unit and hay per roughage consuming animal unit, 48 States only.

2/ Includes seeds, skim milk, and corn for forage, but excludes corn in silage.

3/ Quantity expressed in equivalent feeding value of corn.

Source: (49, 50).

reports. However, sorghum dry milling may have averaged nearly 179 million pounds during 1967-76, i.e. total industrial use (table 1) less sorghum used at distilleries (table 16). As of 1978, no sorghum was being wet milled.

24

-- = Not available.

2/ Recent research indicates sorghum has 94 to 95 percent of corn's value for feeding swine (25).

Source: (48).

Table 17--Grains used at distilleries for distilled spirits 1/

Year ending Dec. 31	Corn	Rye	Malt	Wheat	Sorghum	Other grains	Total	Sorghum as a percentage of total
	<u>1,000 pounds</u>							<u>Percent</u>
1950	2,221,351	384,247	370,657	39,667	237,851	50	3,253,823	7.3
1951	1,746,099	334,869	340,452	68,346	551,758	35,867	3,077,392	17.9
1952	889,503	156,403	136,616	15,866	58,302	1,128	1,257,817	4.6
1953	1,096,914	237,129	167,211	12,649	2,757	7,751	1,524,411	.2
1954	1,216,578	274,477	182,728	12,625	28,444	1,918	1,716,769	1.7
1955	1,341,328	259,266	198,224	10,911	111,289	--	1,921,017	5.8
1956	1,420,125	241,455	206,595	23,117	118,408	16,960	2,026,660	5.8
1957	1,524,160	248,518	206,228	13,724	87,934	13,896	2,094,459	4.2
1958	1,636,623	260,591	213,173	8,627	100,906	7,363	2,227,283	4.5
1959	1,823,433	295,418	250,459	9,798	131,362	7,269	2,517,739	5.2
1960	1,707,043	310,176	253,088	25,557	305,071	--	2,600,935	11.7
1961	2,055,739	274,657	242,462	29,793	138,205	3,656	2,744,514	5.0
1962	1,804,654	222,657	199,519	45,980	82,640	618	2,356,069	3.5
1963	1,494,122	201,128	191,088	46,618	151,928	1,183	2,086,067	7.3
1964	1,542,342	213,181	202,677	48,293	190,110	5,776	2,202,380	8.6
1965	1,550,808	226,546	209,397	54,103	194,830	5,634	2,241,318	8.7
1966	1,614,701	254,535	224,601	64,075	155,614	18,876	2,332,401	6.7
1967	1,954,554	268,699	244,075	58,981	171,527	2,187	2,700,023	6.4
1968	1,907,792	260,658	230,954	62,728	153,919	2,851	2,618,901	5.9
1969	1,808,869	254,799	223,968	84,410	188,367	30,903	2,591,316	7.3
1970	1,646,463	221,194	181,573	47,178	185,258	12,785	2,294,453	8.1
1971	1,322,191	175,057	151,905	44,715	210,293	5,341	1,909,503	11.0
1972	1,367,453	158,996	140,834	50,080	246,070	326	1,963,760	12.5
1973	1,803,333	173,574	136,432	50,207	93,961	2,147	2,259,654	4.2
1974	1,625,352	105,688	104,244	67,710	161,610	--	2,064,604	7.8
1975	926,539	97,435	77,247	88,769	169,339	3,477	1,362,807	12.4
1976	1,128,255	107,546	87,181	119,361	161,049	5,845	1,609,236	10.0
1977	1,138,728	112,181	98,732	126,6	156,195	25,383	1,657,821	9.4

-- = None reported.

1/ Registered distilleries, 1950-1957; all distilled spirits plants, 1958-1977.

Source: (57).

## U.S. Exports

Sorghum is a human food source, especially in developing areas of Asia and Africa. It is widely used by the meat, milk, and egg industries in the more developed countries as a feed grain. However, U.S. sorghum exported is not generally used for food.

The United States, producing about 30 percent of the total world sorghum, has been a major exporter since 1949, supplying an average of 67 percent of annual exports among the major exporting countries (table 18). The largest U.S. world market share was 90 percent in 1950 and the smallest was 37 percent in 1952.

Sorghum exports increased at about the same rate as total feed grain exports. However, the United States is more dominant in the world sorghum industry than in other feed grains with the exception of corn. Exports rose from an average of 133 million bushels during 1967-71 to more than 226 million bushels during 1972-76. Availability of domestic competing feed grains, their relative prices, and foreign grain production continue to have an impact on sorghum exports. Nevertheless, exports averaged about 29 percent of total U.S. sorghum use from 1972 to 1979.

Export demand has shown considerable variability over the past decade. Most U.S. exports were sent to Japan, India, and Israel. These three countries averaged 62 percent of the U.S. sorghum exports between 1965 and 1979. Japan alone took nearly half of the U.S. sorghum exports, India and Israel averaged 7 and 11 percent, respectively.

### MARKET STRUCTURE AND PRACTICES

Sorghum is generally used as a feed grain in the United States. In the prewar period of 1935-39, almost three-fourths of U.S. sorghum production was used as feed and seed on the farms where it was produced. However, by the early seventies, farmers sold about three-fourths of their crop, using the remainder on the farm. Most U.S. sorghum now is used commercially.

### Flow Volume and Influencing Factors

The marketing system through which sorghum moves and the volume estimates for the 1975/76 marketing year are shown in figure 2. The bulk of off-farm sales moves into country elevators, with smaller amounts moving directly into feed manufacturing and feedlots.

Although off-farm sales have increased both absolutely and relatively, there is no unified system by which producers coordinate sales or other marketing decisions. Producers operate in a highly competitive environment with no influence over the general price level. Marketing alternatives include forward contracting, selling at harvest or after a period of storage, or feeding directly to livestock. Producers speculate in the cash market throughout the planting-harvesting-storing periods if they have not forward contracted at a fixed price or attempted a cross hedge with corn futures.

The planting period for sorghum producers in the four major producing States--Texas, Kansas, Nebraska, and Oklahoma--runs from early March through June (table 19). Texas experiences the longest planting and harvesting periods due to the latitudinal range of the growing area. Producers generally face 5- to 6-month planting/harvest period during which they are subject to price risk if they have not obtained a fixed forward price by some method. Using May and October as representative planting and harvesting months, respectively, it appears that 1971 was a good year to forward price, while crops for 1972 through 1975 were best sold at harvest (table 20). In contrast, farm

Table 18--Sorghum grain exports by major exporting countries

Year <sup>1/</sup>	United States	Argentina	Mexico	France	South Africa	Sudan	Australia	World total	U.S. share
	1,000 metric tons								Percent
1950	2,001	13	--	2/	9	--	75	2,212	90
1951	1,836	95	--	1	15	17	48	2,662	69
1952	288	85	--	2/	7	50	54	789	37
1953	212	20	--	1	76	78	52	557	38
1954	890	40	--	1	40	25	61	1,189	75
1955	1,850	24	5	2	15	3	40	2,125	87
1956	736	133	1	2	11	53	35	1,101	67
1957	1,075	171	2/	2	66	55	13	1,484	72
1958	2,402	221	2/	1	39	65	81	2,916	82
1959	2,518	229	2/	1	54	116	73	3,099	81
1960	2,194	217	2/	10	44	137	6	2,079	81
1961	2,179	689	2/	10	126	87	43	3,208	67
1962	3,018	373	1	40	4	72	55	3,778	80
1963	2,545	702	2	4	70	86	13	3,604	71
1964	3,018	707	2/	12	114	74	14	4,081	74
1965	6,177	513	2/	29	172	126	7	7,288	85
1966	7,101	1,239	21	74	86	28	43	8,919	80
1967	4,400	558	170	39	168	90	52	5,600	79
1968	2,695	1,339	175	107	251	38	73	4,792	56
1969	3,024	1,523	250	89	43	3	53	5,084	59
1970	4,200	2,149	200	101	148	18	517	7,396	57
1971	2,640	1,243	--	165	236	51	990	5,467	48
1972	4,858	1,161	--	146	137	66	712	7,181	68
1973	6,205	2,776	--	178	91	47	797	10,603	59
1974	4,866	2,494	--	120	168	75	856	9,224	53
1975	6,045	2,612	--	234	122	300	815	11,076	55
1976	6,587	4,639	--	85	--	10	828	12,953	51
1977	5,743	4,405	--	190	100	150	384	11,145	51
1978	4,976	4,000	--	233	200	100	360	10,109	49
1979	5,842	3,300	--	200	100	100	1,000	10,833	54

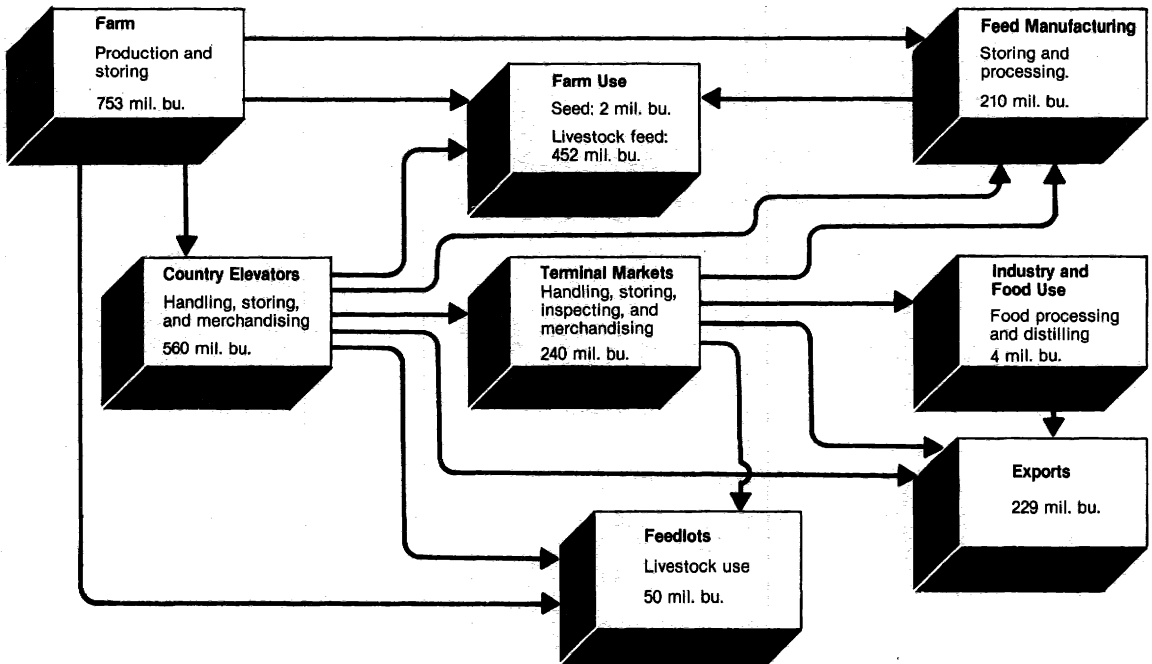
-- = Not available.

<sup>1/</sup> Year beginning July 1.<sup>2/</sup> Less than 500 metric tons.

Source: (42, 56).

Figure 2

## Estimated Sorghum Marketing Flows, 1975/76 Marketing Year



price declined from planting to harvest during 1976-78. Texas farm prices were assumed to be representative of other States' prices. How producers should handle their selling depends on (1) the profitability of the offered forward contract price, (2) personal convictions regarding expected price trends between planting and harvest, and (3) personal willingness to bear risk.

Grain may move from farms to elevator, feedmill, or feedlot. Price may be (1) fixed by forward contract or (2) the local spot market price at the time sorghum is delivered. In some cases, delayed pricing, where sorghum is delivered but producers can "call" their price later based on a specified corn futures contract price less some pre-arranged basis, has been used. Cash price sales at harvest or after storage and delayed pricing are speculative. Producers could attempt to forward price by cross hedging by selling corn futures contracts but they should be well informed on the attendant risks.

### Assembly

Commercial marketings in the major producing States traditionally comprise about 80 percent of the crop. Most sorghum grown in the principal producing States is sold to a country elevator with feedlots and feed mills being the other major buyers (6). Further, sorghum from these States is moved to terminal markets and Gulf Port and West Coast export locations. Elevators in the less important producing States usually assemble sorghum for feeding in local areas. Limited quantities of sorghum are grown under contract for seed and special processed uses.



Table 19--Usual planting and harvesting dates for U.S. sorghum

State	Usual planting dates	Usual harvesting dates		
		Begin	Most active	End
Alabama	June 1-July 15	Sept. 15	Oct. 1-Nov. 1	Nov. 15
Arizona	Mar. 15-July 15	July 15	Aug. 1-Nov. 25	Dec. 15
Arkansas	Apr. 25-July 1	Aug. 25	Sept. 1-Oct. 15	Nov. 5
California	May 1-Aug. 1	Sept. 15	Oct. 1-Nov. 20	Nov. 25
Colorado	May 10-July 5	Oct. 1	Oct. 10-Nov. 15	Nov. 25
Georgia	Apr. 20-July 20	Oct. 10	Oct. 25-Nov. 10	Dec. 1
Illinois	May-10-June 20	Oct. 10	Oct. 20-Nov. 20	Dec. 10
Indiana	May 5-June 5	Sept. 25	Sept. 30-Oct. 10	Oct. 15
Iowa	May 5-June 5	Oct. 15	Oct. 20-Nov. 15	Nov. 20
Kansas	May 10-July 1	Sept. 20	Oct. 10-Nov. 10	Dec. 1
Kentucky	May 1-June 20	Oct. 1	Oct. 15-Nov. 1	Nov. 10
Louisiana	May 15-July 1	Aug. 15	Sept. 1-Oct. 1	Oct. 15
Mississippi	Apr. 25-July 5	Sept. 10	Oct. 10-Nov. 10	Nov. 20
Missouri	May 15-June 20	Sept. 15	Oct. 15-Nov. 15	Dec. 10
Nebraska	May 5-June 15	Sept. 20	Oct. 5-Oct. 25	Nov. 15
New Mexico	May 10-July 10	Oct. 1	Oct. 10-Nov. 10	Dec. 1
North Carolina	May 1-July 5	Aug. 15	Sept. 5-Oct. 1	Oct. 15
Oklahoma	Apr. 25-June 25	Sept. 5	Sept. 10-Nov. 25	Nov. 30
South Carolina	June 1-July 1	Sept. 10	Sept. 20-Oct. 20	Nov. 10
South Dakota	May 15-June 20	Oct. 1	Oct. 10-Nov. 1	Nov. 10
Tennessee	May 15-July 15	Sept. 10	Oct. 10-Oct. 20	Nov. 1
Texas	Mar. 1-July 1	July 1	Sept. 10-Sept. 30	Nov. 20
Virginia	May 10-July 1	Sept. 25	Oct. 1-Nov. 5	Nov. 25

Source: (54).

Table 20--Sorghum prices received by Texas farmers

Season	Month		May to October change	
	May	October		
	<u>Dollars per hundredweight</u>			<u>Percent</u>
1970	1.87	2.03	+0.16	+8.6
1971	2.45	1.88	-.57	-23.3
1972	1.95	2.16	+.21	+10.8
1973	2.85	3.47	+.62	+21.7
1974	3.76	5.82	+2.06	+54.8
1975	4.24	4.46	+.22	+5.2
1976	4.29	3.27	-.52	-12.1
1977	3.29	3.13	-.16	-4.9
1978	3.93	3.66	-.27	-6.9
1979	3.96	4.46	+.50	+12.6

Source: (28).

#### Storage

Commercial storage capacity for storing and handling grain sorghum and other grains has increased rapidly since World War II. This increase occurred both in exports and domestic locations, particularly on routes between producing areas and Gulf Port shipping points. Texas, for example, had seven times as much commercial storage space in the early sixties as in the late forties.

Texas, Kansas, and Nebraska are ranked first, second, and fifth, respectively, in off-farm commercial storage capacity (table 21). These three States accounted for approximately 31 percent of the country's total off-farm commercial storage capacity as of April 1, 1978. Much of it is located at terminal centers. This facilitates the shipment of sorghum to industrial users and primarily to export locations. Terminal elevator locations are given in table 22.

The emergence of commercial feedlots in the sorghum belt and expansion in use of formula feed rations together have relieved some of the need for onfarm grain storage capacity for feeding uses. Onfarm storage generally has been more profitable on farms that used grain for local feeding enterprises. However, farming and livestock feeding operations have become more specialized in recent years. This has resulted in larger cash sales of grain. Due to increases in grain carryover levels and changes in Government philosophy toward grain reserves, CCC changed its loan program in 1977 and 1978 to encourage additional construction of onfarm storage.

Table 21--U.S. food and feed crop storage capacity and prospective commodity supplies, 1977-78

Selected States	Onfarm storage capacity				Off-farm commercial storage capacity	Total storage as of April 1, 1978	Potential grain and oilseed supply, October 1	
	Shelled grain and oilseeds	Permanent ear corn	High moisture grain	Total farm			1977	1978
	Million bushels							
Illinois	947	130	77	1,154	787	1,941	1,733	1,712
Indiana	430	52	25	507	283	790	860	792
Iowa	1,071	293	128	1,492	635	2,127	1,734	2,042
Kansas	341	4	25	370	831	1,201	959	898
Minnesota	996	107	89	1,192	368	1,560	1,185	1,200
Missouri	309	20	17	346	211	557	505	444
Nebraska	716	51	66	833	488	1,321	1,092	1,130
North Dakota	681	1	9	691	142	833	544	668
Ohio	225	51	16	292	244	536	640	587
South Dakota	394	28	21	443	85	528	379	466
Texas	239	6	19	264	838	1,102	735	608
Total 12 States	6,594	853	574	8,021	5,042	13,063	10,801	10,949
Other States	1,523	221	159	1,903	1,945	3,848	2,886	3,104
U.S. total	8,117	1,074	733	9,924	6,987	16,911	13,687	14,053

Source: (38).

Table 22--Grain storage capacity of country, terminal, and private storage facilities, January 1978

State	Country elevators <u>1/</u>	Terminal elevators <u>1/</u>	Private storage <u>2/</u>	Total capacity <u>3/</u>
	<u>1,000 bushels</u>			
Kansas	445,352	291,337	93,311	830,000
Nebraska	321,787	120,949	41,864	484,600
Oklahoma	107,286	79,133	17,101	203,520
Texas	375,523	287,073	57,754	720,350
Four-State total	1,249,948	778,492	210,030	2,238,470

1/ Capacity of warehouses operating under a Uniform Grain Storage agreement with the CCC.

2/ Off-farm storage capacity not covered by a grain storage agreement with CCC.

3/ Rated off-farm storage capacity as reported by the Crop Reporting Board, Econ. Stat. Coop. Serv., U.S. Dept. Agr.

Grain storage is profitable whenever grain price increases are greater than storage costs. Producers should be familiar with local seasonal price trends before making storage and marketing decisions.

Elevators in the present marketing system compete against each other for all markets. Most local elevators sell some grain for export to the larger private grain firms. Larger regional cooperatives have export facilities and can export directly, bypassing the large grain firms.

Outside interests are entering the grain elevator business, according to a 1973 study (23). Approximately 40 percent of Texas High Plains elevators sampled in the study were linked with other businesses. Most of these were not cooperatively owned and were linked closely with feedlots. The extent of their linkage to feedlots is apparently expanding, and possibly could result in changes in sorghum marketing channels. However, nearly all grain elevators buy and sell grain on their own accounts. Other grain elevator manager/owner activities include custom storage, input supplies, CCC storage, feed milling, and service as sales agent.

### Transportation

Selection of the transportation mode (truck or rail) for sorghum is generally influenced by distance of shipment. All grain obtained by elevators directly from producers was delivered by truck, according to a study of Texas feed grain flows and transportation for 1974 by Fuller and Knudson (6). Grain received by elevators from other sources, including out-of-State, was shipped by both rail and truck. In Texas, 56 percent of the intrastate sorghum shipments among elevators were by truck, and 44 percent were by rail. About two-thirds of the grain received at Texas elevators from out-of-State sources arrived by rail.

Fuller and Knudson also reported that feedmills and feedyards received nearly all their sorghum by truck (6). Many feedyards do not have the choice of transportation modes because they do not have rail service. Kansas and Nebraska were the major out-of-State sources of sorghum for Texas elevators and feedmills. Northern High Plains elevators received 69 and 19 percent of their out-of-State grain from Kansas and Nebraska, respectively. Feedmills in east Texas, a major commercial feed manufacturing area, received about three-fourths of their out-of-State sorghum from Kansas. Almost 57 percent of Texas-bound sorghum from Kansas was by rail, while 99 percent from Nebraska was by rail.

### Processing and Manufacturing

Processing and manufacturing is an important marketing function for sorghum. Mixed feed manufacturers are the major processors of sorghum. Distillers and millers are of lesser importance.

The prepared animal feed manufacturing industry purchases sorghum from farmers, country elevators, and terminal elevators. It also utilizes sorghum byproducts of the distillers and millers industries. In 1975, 3,428 primary feed manufacturing establishments used about 5.6 million tons of sorghum in the production of animal feeds. Sorghum represented 15 percent of total grain tonnage used by the industry in 1975 (59). The Southern Plains, Northern Plains, Pacific, and Mountain regions are major feed-sorghum production areas. Feed plants in those regions accounted for 89 percent of the total quantity used by the industry in 1975. Sorghum is generally used by feed manufacturing establishments located near sorghum production locations. The weighted average distance of establishments from principal supplies of sorghum was 392 miles in 1969 (11). The Pacific region, a deficit feed grain producing area, averaged 996 miles. The remaining three major areas transported sorghum to the prepared animal feed plants at distances below the U.S. average.

Grain products manufactured for food or industrial use come largely from dry milling, wet milling, matting, fermentation, and breakfast food manufacture. Accurate data on sorghum use by any of these processing industries are difficult to obtain due to the limited number of firms. In the late sixties, an estimated 40 percent of the sorghum for food and industrial use was wet milled, 40 percent was fermented, and 20 percent was dry milled (59). By 1978, no known sorghum was wet milled.

### Grain Standards

The sorghum marketing industry is facilitated by inspection and grading services performed by Federal and State grain inspection agencies. Sorghum is divided into four classes: yellow, white, brown, and mixed (44). Yellow sorghum has yellow, salmon-pink, red, or white but spotted pericarps, contains not more than 10 percent of sorghum with brown pericarps or subcoats, and does not meet the requirements for the white class. White sorghum has white pericarps and contains not more than 2 percent of sorghum with pericarps or subcoats of other colors. Brown sorghum has brown pericarps or brown subcoats and contains not more than 10 percent of sorghum of other colors. Mixed sorghum is that which does not meet the standards for the yellow, white, or brown classes. Sorghum grades are U.S. numerical grades (U.S. No. 1 through U.S. No. 4), U.S. sample grades, and special grades. These special grades are smutty and weevily (table 23).

Table 23--Grade and grade requirements for all classes of sorghum

Grade <u>1/</u>	Maximum limits of--				
	Minimum test weight per bushel	Moisture	Damaged kernels		Broken ker- nels, foreign materials and other grains
			Total	Heat damaged kernesl	
	Pounds		Percent		
U.S. No. 1	57.0	13.0	2.0	0.2	4.0
U.S. No. 2	55.0	14.0	5.0	.5	8.0
U.S. No. 3 <u>2/</u>	53.0	15.0	10.0	1.0	12.0
U.S. No. 4	51.0	18.0	15.0	3.0	15.0

U.S. sample grade--U.S. sample grade shall be sorghum which:

- (a) does not meet the requirements for grades U.S. Nos. 1, 2, 3, or 4,
- (b) contains more than 7 stones which have an aggregate weight in excess of 0.2 percent of the sample weight or more than 2 crotalaria seeds (crotalaria spp.) per 1,000 grams of sorghum,
- (c) has a musty, sour, or commercially objectionable foreign odor (except smut odor), or
- (d) is badly weathered, is heating, or is of distinctly low quality.

1/ Special grades supplemental to the designated grades are:

- (1) Smutty: Sorghum which is covered with smut spores or which contains 20 or more smut masses in 100 grams of sorghum.
- (2) Weevily: Sorghum which is infested with live weevils or other live insects injurious to stored grain.

2/ Sorghum which is distinctly discolored shall not be graded higher than U.S. No. 3.

Source: (44).

#### Futures Prices

Farmers who grow or store sorghum but have not forward contracted at a set price or used some other forward price setting technique are clearly speculating in the cash market. Cash or spot prices for sorghum were significantly higher during 1975-79 than 1965-69 at \$3.77 and \$1.80 per hundredweight, respectively. However, prices were more variable during 1975-79 than 1965-69, with coefficients of variation of 10.7 and 4.5 percent, respectively. Thus, price risk has increased considerably since 1969.

Merchants, processors, and/or storage firms frequently use futures markets to reduce price risk through forward buying and selling. That is, if they buy so many bushels of grain, they can protect against a price decline to some extent by an offsetting sale of approximately the same number of bushels in futures contracts. Since cash and futures prices usually move together, a loss on the cash side is offset by a gain on the futures side. Hence, the owner of the grain can hedge against much of the price

risk inherent in grain ownership. It should be remembered that hedges protect against both price declines and price increases.

The farmer faces both yield and price risks in hedging a crop, while a grain buyer in possession of the actual commodity faces only price risk. While grain buyers have used futures markets effectively, farmers have used futures contracts very little. Unfortunately, farmers frequently speculate when they do use futures.

Trading in sorghum futures was initiated at the Kansas City Board of Trade in 1944 and at the Chicago Board of Trade in 1951. Agricultural crop producers experienced very stable prices for several years prior to 1972 and found little need for either forward contracting or hedging with futures contracts. In any event, hedging sorghum with sorghum futures is not feasible at present because the volume of trade in sorghum futures is not adequate to facilitate ease of market entry and exit for hedging purposes. Note that the volume of trading in corn futures is several times the level of actual production, while sorghum futures trading is practically nonexistent (table 24).

Some well informed and experienced traders apparently cross hedge sorghum with corn futures contracts due to the generally similar movements in corn and sorghum prices. Comparison of weekly Houston export prices for sorghum and Chicago corn futures prices for the 1968-78 period revealed seasonal patterns suggesting the usefulness of corn futures in reducing sorghum price risk to elevators subject to export prices (61). Such hedgers need a full appreciation of the risks involved in cross hedging and, in particular, the fact that sorghum cannot be delivered against a short hedge with corn futures. Delivery is not common but would be highly desirable in the case of a squeeze. The question is one of how much risk the producer or owner of sorghum is willing to bear. The absence of a forward contract or cross hedge means speculating in the cash market. Forward contracting at a fixed price leaves a producer with no flexibility should prices rise but should protect against a price decline if the contractor performs. Cross hedging with corn futures provides some flexibility but introduces risk because corn futures and sorghum cash prices do not move together perfectly. In addition to price risk, producers almost always face yield risks in forward pricing arrangements unless an acreage contract is involved.

Futures prices are frequently used to establish specific cash prices. This is generally true for cotton and also occurs for some grains. For example, merchants may be pricing sorghum at so many points above or below a particular corn futures contract price. Recent information from the Texas Coastal Bend sorghum producing area indicates that the local export price for grade U.S. No. 2 sorghum was based on the July corn futures price. The basis or difference between the July U.S. No. 2 corn futures price and the U.S. No. 2 sorghum price varied daily, depending on the buyer's assessment of world supply and demand, current stocks, local export market situation, and storage and handling costs (19). The country elevators then adjusted the local export price by freight, handling, and storage charges to arrive at a price offered to farmers. Later during the season, March corn futures price would be used as a price base. In cases such as these, corn futures and sorghum cash prices are clearly linked. While pricing arrangements vary among locales, some attention will be paid to corn futures as sorghum buyers need to hedge against price risk unless they have fixed price forward contracts at time of purchase.

While sorghum futures trading for hedging sorghum is not presently practical due to an inadequate volume of contracts traded, the corn futures market is important in the pricing of sorghum due to the competitiveness of the two grains. Under certain circumstances, corn futures can be used for cross hedging sorghum.

Table 24--Estimated number of transactions and volume and value of futures traded on sorghum and corn futures

Year	Sorghum			Corn		
	Trans- actions	Volume traded	Value	Trans- actions	Volume traded	Value
	<u>1,000</u>	<u>Million pounds</u>	<u>Million dollars</u>	<u>1,000</u>	<u>Million bushels</u>	<u>Million dollars</u>
1965	--	--	--	740	3,702	4,644
1966	--	--	--	1,075	5,376	6,658
1967	12	3,402	71	2,614	13,068	18,399
1968	2	708	13	1,512	7,560	8,937
1969	2	483	9	1,642	8,212	9,948
1970	<u>2/</u>	130	7	2,151	10,575	15,301
1971	9	1,739	38	2,084	10,422	14,217
1972	1	417	10	1,955	9,775	13,202
1973	2	926	38	4,177	20,887	46,747
1974	1	543	29	4,813	24,067	79,199
1975	1	268	12	5,001	25,004	73,185
1976	<u>2/</u>	4	7	4,693	23,465	67,018
1977	<u>2/</u>	4	<u>3/</u>	5,073	25,363	58,374
1978	<u>4/</u>	<u>4/</u>	<u>4/</u>	--	30,635	--

-- = Not available.

1/ A contract unit for sorghum grain is 280,000 pounds for Kansas City Board of Trade, and 400,000 pounds beginning with the September 1972 futures, and 200,000 pounds prior to that with the Chicago Mercantile Exchange.

2/ Fewer than 500 transactions.

3/ Less than \$50,000.

4/ Trading suspended.

Source: (29).

#### COSTS AND PRICES

Per acre and per bushel sorghum production costs, excluding land costs, are consistently lowest in the Central Plains where 14.7 percent of production is on irrigated land (tables 25, 26) (33, 34). The highest unit costs are in the Southwest, where all



Table 25--Sorghum production costs per planted acre <sup>1/</sup>

Cost item	Central Plains				Southern Plains				Southwest				Three-region average			
	1975	1976	1977	1978	1975	1976	1977	1978	1975	1976	1977	1978	1975	1976	1977	1978
Dollars per acre																
Variable	46.14	45.35	50.00	52.23	55.49	59.60	56.16	60.96	121.48	135.82	144.14	151.22	53.25	54.48	54.18	57.86
All labor	7.05	8.15	9.67	10.42	10.34	11.99	13.30	14.07	27.27	28.98	35.95	39.04	9.41	10.53	11.67	12.53
Chemicals <sup>2/</sup>	4.67	4.47	4.06	3.83	3.16	2.27	1.90	1.85	11.65	2.34	2.11	2.00	3.97	3.33	3.08	2.95
Custom operations <sup>3/</sup>	3.78	4.27	4.48	4.73	5.98	4.98	4.14	4.82	10.76	7.09	5.18	4.96	5.20	4.68	4.34	4.77
Drying	.58	1.16	1.70	2.17	0	0	0	0	0	0	0	0	.23	.56	.93	1.20
Fertilizer	16.40	12.12	12.32	12.14	16.51	12.36	11.76	11.89	39.14	28.75	29.45	29.70	17.00	12.61	12.35	12.37
Fuel and lubrication	5.20	5.68	6.88	7.37	7.84	14.02	10.83	12.51	8.38	45.69	30.76	26.80	6.78	10.72	8.99	9.94
Interest	1.39	1.10	1.14	1.29	1.81	1.55	1.44	1.61	4.03	3.87	4.19	5.32	1.69	1.39	1.32	1.50
Lime	.03	.03	.02	.02	0	0	0	0	0	0	0	0	.01	.02	.01	.01
Miscellaneous	.02	0	0	0	0	0	0	0	<u>4/</u> 5.71	0	<u>4/</u> 17.30	<u>4/</u> 23.28	<u>4/</u> .14	0	<u>4/</u> .27	<u>4/</u> .45
Repairs	4.28	5.38	6.14	6.70	6.65	9.26	9.40	10.75	7.68	11.99	12.06	12.55	5.72	7.46	7.66	8.54
Seed	2.74	2.99	3.59	3.56	3.20	3.17	3.39	3.46	6.86	7.11	7.14	7.57	3.10	3.18	3.56	3.60
Machinery ownership cost	18.16	19.75	21.97	24.90	25.76	29.98	31.85	38.19	22.75	42.89	37.28	40.76	22.62	25.37	26.54	30.87
Replacement	11.23	13.20	14.66	15.82	16.08	20.63	21.71	25.06	14.72	29.36	25.18	25.96	14.09	17.26	17.91	19.95
Interest	5.39	5.14	5.43	6.96	7.35	7.40	7.62	10.13	6.42	10.62	8.99	11.41	6.54	6.39	6.44	8.40
Taxes and insurance	1.54	1.41	1.88	2.12	2.33	1.95	2.52	3.00	1.61	2.91	3.11	3.39	1.99	1.72	2.19	2.52
General farm overhead	5.51	5.85	6.23	6.63	5.42	5.75	6.13	6.52	9.61	10.20	10.87	11.56	5.56	5.90	6.26	6.67
Management <sup>5/</sup>	7.04	5.53	7.82	8.38	7.66	5.85	9.41	10.57	13.73	12.03	19.23	20.35	7.53	5.84	8.70	9.54
Total, excluding land	76.85	76.48	86.02	92.14	94.33	101.18	103.55	116.24	167.62	200.94	211.52	223.89	88.96	91.59	95.68	104.94
Land allocation, composit with:																
Current value <sup>6/</sup>	36.08	32.20	41.07	42.00	30.94	25.48	26.68	28.56	69.42	68.62	73.56	82.01	34.03	29.67	35.27	37.04
Acquisition <sup>7/</sup>	24.74	20.47	26.13	27.58	23.60	16.58	17.13	17.74	47.85	45.63	49.72	56.42	24.60	19.10	22.56	23.94

<sup>1/</sup> Regions for the production of sorghum are: Central Plains--South Dakota, Nebraska, Kansas, Colorado, and Missouri; Southern Plains--Oklahoma, Texas, Arkansas, and New Mexico; Southwest--Arizona and California.

<sup>2/</sup> Includes herbicide, insecticide, and rodenticide materials not otherwise included under custom operations.

<sup>3/</sup> Includes custom application of crop chemicals, and custom harvesting and hauling.

<sup>4/</sup> Irrigation water.

<sup>5/</sup> In 1975 and 1976, the management charge was computed as 7 percent of the value of the crop. In 1977 and 1978, the management charge was computed as 10 percent of the variable, machinery, ownership, and general farm overhead costs.

<sup>6/</sup> Based on prevailing tenure arrangements in 1974, reflecting actual combinations of cash rent, net share rent, and owner-operator land allocations, land tax rates, and cash rents updated to current year.

<sup>7/</sup> In 1975, details in footnote 6 apply, with the exception that for owned land, the average value of cropland at time of acquisition is used; in 1976-1978, details in footnote 6 apply, except average value of cropland during the last 35 years was used for owner-operator.

Source: (33, 34).

Table 26--Sorghum production costs per bushel <sup>1/</sup>

Cost item	Central Plains				Southern Plains				Southwest				Three-region average			
	1975	1976	1977	1978	1975	1976	1977	1978	1975	1976	1977	1978	1975	1976	1977	1978
	<u>Dollars per bushel</u>															
Variable	1.04	0.99	0.81	0.91	1.21	1.32	1.28	1.34	1.77	1.93	1.92	2.16	1.16	1.18	1.00	1.10
Machinery ownership	.41	.43	.36	.43	.56	.67	.72	.84	.33	.61	.50	.58	.49	.55	.49	.59
General farm overhead	.12	.13	.10	.12	.12	.13	.14	.14	.14	.14	.14	.16	.12	.13	.12	.13
Management	.13	.12	.13	.15	.17	.13	.21	.23	.20	.17	.26	.29	.16	.13	.16	.18
Total, excluding land	1.73	1.67	1.40	1.61	2.06	2.25	2.35	2.55	2.44	2.85	2.82	3.19	1.93	1.99	1.77	2.00
Land allocation, composite with:																
Current value	.81	.70	.67	.73	.67	.57	.60	.63	1.01	.97	.98	1.17	.74	.65	.65	.71
Acquisition	.56	.45	.42	.48	.51	.37	.39	.39	.70	.65	.66	.80	.54	.42	.42	.46
Yield per acre	44.30	45.90	61.60	57.20	46.00	45.00	44.10	45.50	68.80	70.40	74.90	70.20	45.80	46.00	54.10	52.50
	<u>Percent</u>															
Percentage of U.S. production	37.90	46.50	60.80	58.90	56.10	47.30	35.30	36.00	3.40	3.30	2.10	2.50	97.40	97.10	97.90	97.40

-- = Not available.

<sup>1/</sup> Regions for the production of sorghum are: Central Plains--South Dakota, Nebraska, Kansas, Colorado, and Missouri; Southern Plains--Oklahoma, Texas, Arkansas, and New Mexico; Southwest--Arizona and California.

Source: (33, 34).

of the Arizona and California production is under irrigation. Approximately 42 percent of production in the Southern Plains is on irrigated land. Increased machinery, labor, and energy costs have a greater impact on irrigated production than on dryland production. The areas with the greatest amount of irrigation show the greatest increases in both per acre and per bushel costs.

Sorghum production costs have increased steadily since 1975. Yields increased almost 17 percent from 45.8 to 52.5 bushels per acre, partially compensating for the drop in season average price of 35 cents per acre in the United States from 1975 to 1978. During the same period, per acre machinery replacement, fuel and lubrication, and labor costs rose \$5.86, \$3.16, and \$3.12, respectively, but were partially offset by substantial decreases in fertilizer and chemical expenses.

### Drying

Total cost for drying grain sorghum in 1976 was 15.4 cents per bushel in a continuous flow dryer and 12.4 cents per bushel in an automatic batch dryer (table 27). Dryer depreciation was the most expensive fixed cost, while LPG (liquified propane gas) was the most expensive variable cost.

### Transportation and Storage

Transportation costs for sorghum increased sharply during the past decade. Cumulative effects of various railroad rate increases caused freight rates to more than double since 1967. Railroad rates and costs for farm and food products have not risen as much as that of all railroad freight in recent years, but they have increased sharply (table 28). Compared with other grains, corn and sorghum are not as expensive to transport per ton mile by railroad (table 29). Interstate rates for corn and sorghum in 1975 were 1.61 cents per ton mile compared to 1.83 to 3.09 cents for all other grains. The intrastate rate was 3.59 cents compared to 3.80 to 4.34 cents, respectively. Ocean freight rates for various U.S. origins and destinations for 1978 and 1979 are shown in table 30.

Handling at U.S. country elevators cost about 5.4 cents per bushel during 1974 (truck receiving plus rail loadout), with annual storage costs averaging about 18 cents per bushel (table 31). The cost of receiving and loading grain at U.S. inland terminals was about 4.8 cents per bushel (truck receiving plus rail loadout) with annual storage costs slightly less than 17 cents per bushel. Receiving costs for U.S. port terminals were nearly the same for truck and rail as country and inland terminal elevators. However, receiving costs by water for port terminals were less than half of those for country and inland terminals. Load-out costs by rail and water at port terminals were comparable to country and inland terminal elevators. Load-out costs by truck at port terminals were about double those at the other facilities. Storage costs were 8.3 cents per bushel higher at port terminals because of greater costs in handling facilities.

### Prices

Roy and Ireland have suggested that U.S. demand for sorghum as feed, domestic and export sorghum prices, sorghum exports, and carryover stocks are interrelated as well as influenced by external variables, such as the U.S. price of corn, number of animal grain consuming units, and world corn and sorghum production (20). Individual producers exert no influence on the general sorghum price level. Producers are in the position of accepting or rejecting prices determined by market forces.

Table 27--Estimated drying costs of two conventional grain-drying systems,  
40,000-bushel capacity, 1976

Cost item	Continuous flow dryer <u>1</u> /	Automatic batch dryer <u>2</u> /
	<u>Cents per bushel</u>	
Fixed:		
Dryer depreciation	5.4	3.9
Equipment depreciation	.4	.4
Electricity hookup	<u>3</u> /	<u>3</u> /
Insurance on dryer and equipment	.3	.2
Interest on investment	2.2	1.6
Taxes (personal property or real estate)	1.0	.8
Subtotal	9.3	6.9
Variable: <u>4</u> /		
Direct labor	.5	.5
Electricity	.1	.1
Liquified propane gas	4.3	4.0
Repairs and maintenance	1.1	.8
Interest on working capital	.1	.1
Subtotal	6.1	5.5
Total cost	15.4	12.4

1/ Capacity of 180 bushels per hour.

2/ Maximum daily filling rate for corn is 2,500 bushels.

3/ Less than 0.1 cent.

4/ Charges for insurance and taxes on grain were omitted under the assumption that these costs are associated with the storage function rather than the drying function.

Source: (8).

Prices received by Texas and Oklahoma farmers tend to be higher than those received in Kansas and Nebraska because of the close proximity to the feedlot industry in the Texas Panhandle, New Mexico, and Arizona and to Gulf Port export facilities (table 32). Sorghum prices also may tend to be lower in Kansas and Nebraska because of later harvesting dates and more direct competition with corn. California's cash price is often the highest in the country because of strong domestic demand (table 33). California is a feed grain deficit State.

World sorghum prices respond to the same general types of factors that affect U.S. prices. Average quarterly prices at Rotterdam and Houston are given in tables 34 and

Table 28--Index of railroad rates and costs, 1972 and 1979

Item	1972	1979	Percentage change
	<u>1967 = 100</u>		<u>Percent</u>
Farm products	123.4	235.0	90.4
Food products	126.2	239.5	89.8
All railroad freight	126.1	243.4	93.0

Source: (58).

Table 29--Interstate Commerce Commission, revenue/cost analysis, noncompensatory rates, 1975

Commodity	Average railroad revenue per ton mile		
	Interstate	Intrastate	Average
		<u>Cents</u>	
Wheat	2.66	3.90	2.80
Corn and sorghum	1.61	3.59	1.76
Barley	3.09	3.80	3.18
All other grains	2.61	3.93	2.70
Soybeans	1.83	4.34	2.10

Source: (58).

Table 30--Average quarterly voyage charter rates for bulk grains, 1978 and 1979 1/

Origin and destination areas	Flag	Quarter								Year
		1978				1979				
		1st	2nd	3rd	4th	1st	2nd	3rd	4th	
<u>Dollars per metric ton</u>										
Great Lakes Ports to:										
United Kingdom	For.	18.57	19.50	18.75	20.86	25.44	25.32	27.18	37.39	27.95
Antwerp-Rotterdam-Amsterdam	For.	15.12	17.47	16.91	20.34	19.53	23.04	23.55	32.71	25.93
Germany (West)	For.	15.03	18.37	16.91	21.73	19.73	22.48	23.83	36.68	27.63
St. Lawrence River Ports to:										
United Kingdom	For.	6.20	9.21	5.82	9.70	10.08	15.92	15.33	16.65	15.51
Antwerp-Rotterdam-Amsterdam	For.	5.80	8.04	2/	8.82	10.00	11.85	15.33	13.65	13.55
Germany (West)	For.	6.88	10.75	2/	2/	2/	14.18	17.83	14.61	15.93
U.S. Atlantic Ports North of Cape Hatteras to:										
United Kingdom	For.	7.23	7.66	11.56	10.62	12.73	17.22	15.26	17.49	15.24
Antwerp-Rotterdam-Amsterdam	For.	5.35	6.24	7.00	9.03	7.93	13.73	14.11	16.29	13.27
U.S.S.R. (Black Sea)	U.S.	14.81	2/	2/	14.81	2/	2/	2/	24.11	24.11
Germany (West)	For.	5.27	6.61	9.11	9.12	8.57	17.11	13.94	16.82	15.13
Spain	For.	9.39	2/	2/	11.09	12.18	2/	2/	20.23	18.57
U.S. Gulf Ports to:										
Antwerp-Rotterdam-Amsterdam	For.	5.25	6.55	6.46	8.47	9.06	13.65	15.56	16.96	13.28
Japan	For.	9.86	13.06	13.66	12.98	14.97	24.39	24.56	25.33	21.52
U.S.S.R. (Black Sea)	U.S.	15.74	2/	2/	15.74	14.88	17.96	2/	2/	18.03
Germany (West)	For.	6.41	7.44	6.47	8.99	8.93	13.67	15.72	17.06	15.13
Italy	For.	13.86	16.97	11.31	2/	22.23	2/	2/	2/	22.23
U.S. Pacific Ports North of San Francisco to:										
India	For.	23.15	27.51	2/	36.03	2/	2/	2/	2/	2/
Japan	For.	10.11	12.69	12.81	15.19	12.59	15.64	22.39	23.73	18.76
Korea (South)	For.	13.31	13.43	16.13	16.79	16.87	19.57	28.24	32.34	23.53

1/ Average of rates for individual cargoes weighted by volume.

2/ None reported.

Source: (41).

Table 31--Replacement and estimated weighted average costs per bushel to handle and store grain, fiscal year 1974 1/

Area and type of facility	Received by--			Loadout by--			Stor- age
	Truck	Rail	Water	Truck	Rail	Water	
	<u>Cents</u>						
Great Lakes:							
Country	: 2.17	--	--	2.79	3.16	1.74	18.00
Inland terminal	: 1.98	2.31	6.05	.79	1.93	.34	13.23
Port terminal	: 2.71	2.43	3.56	3.78	2.81	1.34	23.19
North Plains:							
Country	: 2.32	--	--	1.84	2.24	--	18.35
Inland terminal	: 1.53	2.68	--	5.48	2.50	1.27	9.81
Port terminal	: --	--	--	--	--	--	--
Mid-Plains:							
Country	: 2.65	2.33	--	3.16	2.94	.71	17.14
Inland terminal	: 3.07	3.42	--	2.49	2.47	.87	18.73
Port Terminal	: --	--	--	--	--	--	--
South Plains:							
Country	: 3.15	--	--	2.62	4.62	--	18.70
Inland terminal	: 3.18	3.52	--	3.91	2.90	--	26.60
Gulf port terminal	: 1.43	1.97	1.68	5.55	1.64	.95	26.08
South and East:							
Country	: 1.53	1.82	4.48	3.36	3.53	1.01	21.77
Inland terminal	: 2.23	1.78	3.85	3.21	3.26	2.00	11.84
East port terminal	: 4.00	2.00	3.91	10.87	6.70	2.12	23.54
West:							
Country	: 2.53	--	--	3.28	3.46	--	20.51
Inland terminal	: 2.29	1.71	--	2.64	1.52	.97	16.67
Port terminal	: 3.27	2.42	2.55	4.26	3.53	1.39	30.05
United States:							
Country	: 2.39	2.25	4.47	2.76	3.04	1.12	18.18
Inland terminal	: 2.29	2.97	4.28	2.02	2.49	.90	16.72
Port terminal	: 2.50	2.19	1.79	6.41	2.84	1.13	25.03
All facilities	: 2.39	2.50	1.96	2.72	2.88	1.08	18.44

-- = Not available.

1/ Depreciation and interest on investment based on replacing building and equipment at 1974-1975 price levels.

Source: (39).

Table 32--Sorghum grain prices, four largest producing States

Year	Season average prices per bushel				U.S. average
	Kansas	Nebraska	Oklahoma	Texas	
	<u>Dollars</u>				
1950	1.07	1.01	1.05	1.02	1.05
1951	1.32	1.35	1.29	1.30	1.32
1952	1.45	1.39	1.60	1.58	1.58
1953	1.27	1.20	1.26	1.33	1.32
1954	1.25	1.22	1.23	1.25	1.26
1955	1.01	1.04	.92	.94	.98
1956	1.22	1.14	1.22	1.11	1.15
1957	.97	.96	.92	.97	.97
1958	.98	1.03	.93	.99	1.00
1959	.97	.78	.85	.88	.86
1960	.78	.80	.80	.85	.84
1961	.96	.98	.99	1.02	1.01
1962	.96	1.00	1.00	1.04	1.02
1963	.92	.92	1.00	.99	.98
1964	1.04	.99	1.08	1.04	1.05
1965	.97	.91	1.02	1.01	1.00
1966	1.03	.96	1.08	1.03	1.03
1967	.94	.89	1.00	1.01	.99
1968	.91	.88	.95	.95	.95
1969	.99	.96	1.09	1.10	1.07
1970	1.12	1.08	1.15	1.13	1.14
1971	.95	.93	1.06	1.14	1.05
1972	1.39	1.37	1.41	1.34	1.37
1973	2.13	2.09	2.29	2.09	2.14
1974	2.69	2.69	2.86	2.74	2.77
1975	2.27	2.27	2.35	2.38	2.37
1976	1.90	1.90	2.04	2.18	2.03
1977	1.62	1.65	1.79	1.90	1.82
1978	1.88	1.76	2.02	2.10	2.03

Source: (29).

35, respectively. Japan's spectacular growth in sorghum consumption was a result of that Government placing emphasis on improved diets. The Japanese Government, sometimes at the expense of that country's more traditional crops, devoted substantial resources to the development of livestock and poultry industries. The European Economic Community (EEC), on the other hand, is influenced by different sorghum market mechanisms. The C.I.F. Rotterdam price is a representative European market price since a large share of U.S. feed grains destined for Europe passes through that port to EEC



Table 33--Comparison of cash prices for U.S. No. 2 yellow sorghum and corn  
to average prices received by farmers

Year beginning October 1	Grain sorghum				Corn				
	Cash prices for No. 2 yellow at--			Average Price received by farmers <u>1/</u>	Cash prices for No. 2 yellow at--				Average price received by farmers <u>1/</u>
	Kansas	Fort	Los		Kansas	Fort	Omaha	Chicago	
	City	Worth	Angeles		City	Worth			
Dollars per hundredweight									
1964	2.08	2.39	2.47	1.87	2.34	2.39	2.29	2.34	2.09
1965	1.98	2.27	2.45	1.79	2.38	2.45	2.30	2.36	2.07
1966	2.11	2.40	2.56	1.82	2.41	2.52	2.32	2.43	2.66
1967	1.96	2.27	2.45	1.77	2.14	2.07	2.04	2.04	1.84
1968	1.97	2.31	2.53	1.70	2.20	2.20	2.14	2.18	1.93
1969	2.07	2.42	2.64	1.91	2.34	2.38	2.29	2.34	2.05
1970	2.32	2.73	2.99	2.04	2.59	2.59	2.57	2.63	2.36
1971	2.05	2.51	2.82	1.87	2.27	2.16	2.18	2.21	1.93
1972	3.24	3.75	4.16	2.45	3.45	3.38	2.75	3.41	2.80
1973	4.64	5.13	5.64	3.82	5.20	5.13	5.75	5.27	4.55
1974	5.01	5.62	6.12	4.95	5.50	5.48	5.45	5.57	5.39
1975	4.46	4.93	5.63	4.23	4.80	4.82	4.75	4.91	4.54
1976	3.49	3.64	4.68	3.62	4.04	4.02	3.84	4.11	3.84
1977	3.54	3.88	4.82	3.25	4.07	--	3.72	4.04	3.61
1978	4.00	4.40	5.44	3.61	4.57	--	4.07	4.54	4.02
1979 <u>2/</u>	--	--	--	<u>2/</u> 4.12	--	--	--	--	<u>2/</u> 4.20

-- = Not available.

1/ Includes an allowance for unredeemed loans and purchase agreement deliveries valued at the average loan rate, by States.

2/ Preliminary.

Source: (29, 37).

Table 34--Average quarterly C.I.F. Rotterdam price of U.S.  
No. 2 yellow sorghum

Year beginning October 1	October- December	January- March	April- June	July- September
Dollars per metric ton				
1963	57.60	54.68	53.55	52.89
1964	54.89	55.80	54.20	52.76
1965	54.02	52.78	52.33	52.24
1966	54.03	<u>1/</u> 58.10	59.00	57.50
1967	55.76	56.82	55.52	48.02
1968	51.52	<u>2/</u> 54.00	50.48	53.02
1969	56.25	56.60	54.44	62.19
1970	64.89	63.38	58.75	58.73
1971	56.42	60.41	59.55	57.50
1972	47.86	88.64	96.47	118.09
1973	131.02	135.67	119.33	134.54
1974	161.33	131.68	117.19	128.48
1975	123.45	119.39	118.56	119.42
1976	109.06	110.61	96.17	87.69
1977	99.25	101.52	111.57	102.42
1978	113.72	115.87	123.27	146.95
1979	147.72	--	--	--

-- = Not available.

1/ No bid in January 1967.

2/ No bid in March 1969.

Source: (42).

countries. 2/ Grain importers, however, pay variable levies designed to favor EEC producers over external suppliers. Grain prices in the EEC are based on a price considered desirable and attainable, the target price, which is usually above the C.I.F. price. The target price becomes the basis for the threshold price, which is the importer's cost price, including the variable import levy. The variable import levy, in principle, is the difference between threshold and C.I.F. prices. The effect of the variable levy becomes evident if the EEC offers its feed grain at a lower price in order to underbid external suppliers. If the price of the imported grain falls, the levy will be increased, offsetting the price drop in an attempt to maintain the threshold price.

In addition to governmental and institutional systems, world sorghum prices depend upon total world supply and demand of sorghum and other food and feed grains. Factors impacting on the demand-supply relationship could be shifts in demand resulting from

2/ C.I.F. is cost, insurance, and freight. C.I.F. generally means that the seller's price includes the cost of goods, the marine insurance, and all transportation charges to named point of destination.

Table 35--Houston average quarterly export prices for sorghum and corn

Year beginning October and quarter	Sorghum	Corn	Sorghum as a percentage of corn
	<u>- - Dollars per hundredweight - -</u>		<u>Percent</u>
1968:			
July-September	1.87	1.98	94.4
1969:			
October-December	2.09	2.12	98.6
January-March	2.13	2.25	94.7
April-June	2.08	2.38	87.4
July-September	2.18	2.36	92.4
1970:			
October-December	2.29	2.34	97.9
January-March	2.24	2.38	94.1
April-June	2.11	2.51	84.1
July-September	2.25	2.72	82.7
1971:			
October-December	2.48	2.72	91.2
January-March	2.61	2.66	98.1
April-June	2.68	2.83	94.7
July-September	2.33	2.44	95.5
1972:			
October-December	2.24	2.20	101.8
January-March	2.38	2.28	104.4
April-June	2.29	2.35	97.4
July-September	2.42	2.48	97.6
1973:			
October-December	2.88	2.71	106.3
January-March	3.34	3.14	106.4
April-June	3.44	3.78	91.0
July-September	4.45	4.74	93.9
1974:			
October-December	4.72	4.73	99.8
January-March	5.12	5.58	91.8
April-June	4.29	5.05	85.0
July-September	5.42	6.39	84.8

See source at end of table.

Continued

Table 35--Houston average quarterly export prices for sorghum and corn--  
Continued

Year beginning October and quarter	Sorghum	Corn	Sorghum as a percentage of corn
	- - <u>Dollars per hundredweight</u> - -		<u>Percent</u>
1975:			
October-December	6.48	6.64	97.6
January-March	5.08	5.61	90.6
April-June	4.78	5.31	90.0
July-September	5.16	5.63	91.7
1976:			
October-December	4.98	5.07	98.2
January-March	4.95	5.09	97.2
April-June	4.83	5.32	90.8
July-September	4.78	5.34	89.5
1977:			
October-December	4.33	4.66	92.9
January-March	4.44	4.55	97.6
April-June	4.19	4.55	92.1
July-September	3.48	3.63	95.9
1978:			
October-December	4.33	4.46	97.1
January-March	4.45	4.88	91.2
April-June	4.60	5.15	89.3
July-September	5.15	5.53	93.1
1979:			
October-December	5.27	5.26	100.2
January-March	5.20	4.96	104.8

Source: (43).

changes in gross national products or currency exchange rates, political environments, market expectation, technology, and other international and localized phenomena. In addition to these factors, sorghum exporters must know prospective buyers' needs and trade and tariff policies in order to best project the import requirements of specific countries.

## WORLD PRODUCTION, USE, AND TRADE

Sorghum is the fifth most widely grown grain crop in the world (table 36). The more developed countries use most of their sorghum and other coarse grain stocks for livestock and poultry feed. Developing countries have increased total and per capita meat consumption as their incomes have risen, resulting in higher world demand for feed grains.

Sorghum gained significance as a feed grain during the fifties, resulting from the development of hybrids which enabled farmers in more developed countries of the Western Hemisphere and in Australia to grow it competitively with other feed grains. Sorghum's relative importance in the total world grain economy, however, has remained fairly low and stable, fluctuating between 2 and 5 percent of total grain production. Harvested sorghum area amounted to 45.9 million hectares (1 hectare equals 2.471 acres) in 1979, very little change since 1960 (table 37). The 57-percent increase in worldwide sorghum production since 1960 is due to a 56-percent rise in yields.

### Production

Asia, Africa, and North America are the major sorghum producing areas of the world (table 37). The main sorghum producing countries (with 1979 production estimates in million tons) are the United States, 17.4; People's Republic of China (PRC), 15.0; India, 11.4; Argentina, 5.3; Nigeria, 3.8; and Mexico, 3.1. These countries normally produce more than three-fourths of the world total (table 38).

Total world production was an estimated 67.3 million metric tons in 1979, up from 42.8 million metric tons in 1960. Higher yields resulting from expanded fertilizer usage, improved technology, and hybrids accounted for most of the increased production. The PRC, between 1960 and 1979, experienced the largest rise in production, followed by Argentina and Mexico. India, the third largest producer, fluctuated between 7.0 million metric tons production in 1972 and 12.0 million metric tons in 1978. However, India had only a modest rise in production between 1960 and 1979. The United States also showed only a slight increase in production between 1960 and 1979.

The United States accounted for about 37 percent of total world production in the early seventies, an increase in share of 6 percent from 1950 (table 39). Central and South America gained in relative share of world production between 1950 and 1975, at the expense of Africa and South Asia. Eastern and Western Europe accounted for negligible portions of the world crop with combined average shares of about 1 percent.

Argentina has had spectacular growth in its sorghum industry since 1960 with production rising from 1.3 million metric tons in 1960 to a high of 6.9 million metric tons in 1977. Although yields improved about 35 percent between those periods, most of the production increase came from quadrupling harvested acreage (table 40). Mexico has experienced rapid growth in its sorghum industry since 1960. However, yields contributed a larger portion of the production increase than they did in Argentina (table 41).

The sharp rise in PRC sorghum production since 1960 is due entirely to yield increases. Area harvested gradually declined after 1961 (table 42).

Table 36--Grain production in various world regions, 1979 1/

World region	Production						
	Wheat	Rice	Barley	Corn	Sorghum	Other grain	Total
	<u>Million metric tons</u>						
North America	77.4	8.4	16.9	209.8	24.3	14.0	350.8
South America	11.8	12.9	1.2	31.9	7.3	1.2	66.3
Europe	82.9	1.8	68.2	55.2	.7	28.4	237.2
USSR	86.0	2.2	49.0	8.0	0	27.0	172.2
Africa	9.4	8.2	3.9	24.6	10.1	9.7	65.9
Asia	119.2	334.4	20.3	75.9	23.8	18.6	592.2
Oceania	16.3	.7	3.9	.4	1.2	1.5	24.0
World total	402.9	368.6	163.5	405.8	67.3	100.5	1,508.6

1/ Totals may not add due to rounding.

Source: (42).

Table 37--World sorghum supply-distribution, 1960-78

Year beginning July 1	Acres harvested	Yield	Production	Stocks	Imports	Exports	Consumption		
							Feed	Other	Total
	1,000 hectares	Metric tons	----- 1,000 metric tons -----						
1960	45,761	0.94	42,840	15,720	2,654	2,659	14,640	24,655	39,295
1961	44,705	.89	39,756	19,260	3,236	3,242	14,974	26,259	41,233
1962	45,499	.98	44,431	17,777	3,921	3,935	14,715	28,705	43,420
1963	46,476	1.01	46,711	18,774	3,932	3,942	16,975	29,970	46,945
1964	46,302	.99	45,645	18,530	4,404	4,418	16,250	31,397	47,647
1965	47,201	1.04	49,283	16,514	8,532	8,545	21,961	32,687	54,648
1966	48,812	1.14	53,441	11,136	7,253	7,269	24,429	30,595	55,024
1967	48,463	1.22	58,948	9,537	5,994	6,030	21,587	36,122	57,709
1968	47,788	1.20	57,117	10,740	4,673	4,702	23,565	34,547	58,102
1969	50,239	1.21	60,947	9,726	5,685	5,726	26,072	36,382	62,454
1970	49,920	1.23	61,417	8,178	7,769	7,815	29,892	35,078	64,970
1971	49,000	1.28	62,665	4,579	4,888	4,920	28,494	33,028	61,528
1972	47,034	1.30	60,972	5,684	8,804	8,845	27,799	34,504	62,303
1973	49,469	1.40	69,277	4,312	10,787	10,838	32,704	35,912	68,616
1974	47,796	1.29	61,617	4,922	9,548	9,605	26,000	35,786	61,786
1975	48,307	1.36	65,807	4,696	11,794	11,839	29,430	36,455	65,881
1976	48,374	1.38	66,561	4,577	12,352	12,025	29,826	35,470	65,296
1977	48,216	1.46	70,496	6,169	10,536	10,996	30,701	36,464	67,165
1978	47,781	1.45	69,397	9,040	9,778	11,117	32,027	36,267	68,304
1979	45,855	1.47	67,294	8,794	10,158	10,133	31,873	37,932	69,805

Source: (42).

Table 38--Sorghum production, major producing countries and world

Year 1/	United States	PRC	India	Argentina	Nigeria	Mexico	Australia	Other countries	World
<u>Million metric tons</u>									
1960	15.7	6.4	9.8	1.3	4.0	0.2	0.2	5.2	42.8
1961	12.2	7.9	8.0	1.4	4.0	.3	.3	5.7	39.8
1962	13.0	9.6	9.7	1.0	4.5	.3	.3	6.0	44.4
1963	14.9	10.3	9.2	1.3	4.1	.4	.2	6.3	46.7
1964	12.4	10.9	9.7	.9	4.2	.5	.2	6.8	45.6
1965	17.1	10.8	7.6	2.1	4.2	.7	.2	6.6	49.3
1966	18.2	12.6	9.2	1.4	3.2	1.4	.3	7.1	53.4
1967	19.2	15.1	10.0	1.9	3.4	1.6	.3	7.4	58.9
1968	18.6	14.3	9.8	2.5	2.8	2.1	.3	6.7	57.1
1969	18.5	14.2	9.7	3.8	4.1	2.2	.5	7.9	60.9
1970	17.4	15.4	8.1	4.7	4.1	2.4	1.3	8.0	61.4
1971	22.0	15.2	7.7	2.4	3.1	2.2	1.2	8.8	62.6
1972	20.4	14.8	7.0	4.6	3.6	1.8	1.0	7.8	61.0
1973	23.5	15.0	9.1	5.9	3.0	2.9	1.1	8.8	69.3
1974	15.8	14.8	10.4	4.8	3.5	2.8	.9	8.6	61.6
1975	19.1	14.5	9.5	5.1	3.6	3.4	1.1	9.5	65.8
1976	18.3	14.2	10.5	6.6	3.7	3.2	1.0	9.1	66.6
1977	20.1	14.6	11.8	6.9	3.8	2.8	.7	9.8	70.5
1978	19.0	14.0	12.0	6.6	3.8	3.0	1.0	10.0	69.4
1979	17.4	15.0	11.4	5.3	3.8	3.1	1.2	10.2	67.3

1/ Year beginning October 1 for United States; July 1 for PRC, Mexico, Nigeria, other countries, and world; July 1 (1960-69) and November 1 (1970-79) for India; April 1 for Argentina; and April 1 (1960-78) and December 1 (1979) for Australia.

Source: (42).



Table 39--Relative world sorghum production, regional share

Region	1950	1975
	<u>Percent</u>	
North America	31	37
Central America	1	7
South America	0	11
Africa	34	20
West Asia	<u>1/</u>	<u>1/</u>
South Asia	34	21
East Asia <u>3/</u>	<u>1/</u>	1
Oceania	<u>1/</u>	2
Europe	<u>1/</u>	<u>2/</u> 1

1/ Less than 1 percent.

2/ Ninety-seven percent of this from Western Europe.

3/ Data do not include the PRC.

Source: (53).

India, the third largest sorghum producer in the world, devotes three times as much land to sorghum production as the United States, but yields there average less than one-fourth of those in the United States. Modest increases in India's yields more than offset the declines in area during the sixties and seventies (table 43).

Nigeria, the leading African producer, experienced declining production during the sixties and seventies (table 44). Slight increases in area were not enough to offset the general decline in yield.

#### Use

More than half of the world's production of sorghum is used for human consumption (table 37). Sorghum, however, has become relatively more important in the aggregate as an animal feed during the past 20 years, mainly because of rapid expansion of U.S. sorghum production. The United States uses sorghum almost exclusively as a feed grain or for export as a feed grain. World sorghum feed use increased from 37 percent to 46 percent of total world use between 1960 and 1979, respectively. However, total sorghum feed consumption more than doubled during the same time period.

Sorghum use in the PRC, the world's largest sorghum consumer, has changed little since 1967 (table 45). However, U.S. domestic use rose sharply from 10.9 million metric tons in 1960 to 17.8 million metric tons in 1973, largely for feeding livestock. A sharp rise in sorghum price in 1974 reversed this trend. India, the third largest user of sorghum, gradually increased consumption in the sixties, sharply reduced consumption in the early seventies, and quickly returned to the former peak levels by the midseventies. The increase in the sixties was partly due to U.S. shipments of sorghum. Most of India's sorghum consumption is for food. Japan, the world's largest importer, increased from 114,000 metric tons consumption in 1960 to 5.0 million metric tons in 1977. Japan uses sorghum as a feed grain.

Table 40--Area, yield, and production of Argentina sorghum

Year beginning April 1	Area harvested	Yield	Production
	<u>1,000 hectares</u>	<u>Metric ton</u>	<u>1,000 metric tons</u>
1960	553	2.26	1,252
1961	646	2.16	1,394
1962	574	1.66	952
1963	724	1.75	1,267
1964	588	1.46	857
1965	844	2.52	2,130
1966	764	1.81	1,380
1967	1,083	1.75	1,897
1968	1,302	1.91	2,484
1969	1,872	2.04	3,820
1970	2,235	2.09	4,660
1971	1,419	1.66	2,360
1972	2,131	2.16	4,600
1973	2,324	2.54	5,900
1974	1,938	2.49	4,830
1975	1,834	2.76	5,060
1976	2,377	2.78	6,600
1977	2,254	3.06	6,900
1978	2,200	3.00	6,600
1979	1,900	2.79	5,300

Source: (42).

Table 41--Area, yield, and production of Mexico sorghum

Year beginning July 1	Area harvested	Yield	Production
	<u>1,000 hectares</u>	<u>Metric ton</u>	<u>1,000 metric tons</u>
1960	116	1.80	209
1961	117	2.49	291
1962	118	2.52	296
1963	198	2.04	402
1964	276	1.90	526
1965	314	2.38	747
1966	576	2.45	1,411
1967	673	2.48	1,667
1968	830	2.57	2,133
1969	883	2.78	2,456
1970	971	2.83	2,747
1971	965	2.69	2,593
1972	1,063	2.30	2,441
1973	1,160	2.50	2,900
1974	1,137	2.43	2,760
1975	1,170	2.74	3,200
1976	1,170	2.74	3,200
1977	1,190	2.86	3,400
1978	1,100	2.73	3,000
1979	1,100	2.82	3,100

Source: (42, 53).

Table 42--PRC sorghum: Area, yield, and production

Year beginning July 1	Area harvested	Yield	Production
	<u>1,000 hectares</u>	<u>Metric ton</u>	<u>1,000 metric tons</u>
1960	8,970	.71	6,379
1961	9,352	.84	7,878
1962	9,302	1.04	9,643
1963	9,250	1.11	10,267
1964	9,190	1.18	10,881
1965	9,140	1.18	10,768
1966	9,083	1.38	12,556
1967	9,017	1.68	15,139
1968	8,970	1.59	14,289
1969	8,916	1.59	14,179
1970	8,860	1.74	15,398
1971	8,801	1.73	15,199
1972	8,669	1.71	14,845
1973	8,283	1.80	14,950
1974	7,903	1.88	14,835
1975	7,322	1.99	14,542
1976	7,006	2.02	14,150
1977	7,000	2.09	14,630
1978	6,800	2.06	14,000
1979	6,800	2.21	15,000

Source: (42).

Table 43--India sorghum: Area, yield, and production

Year beginning July 1 <u>1/</u>	Area harvested	Yield	Production
	<u>1,000 hectares</u>	<u>Metric ton</u>	<u>1,000 metric tons</u>
1960	18,412	.53	9,814
1961	18,249	.44	8,026
1962	18,414	.53	9,744
1963	18,376	.50	9,195
1964	18,056	.54	9,681
1965	17,679	.43	7,581
1966	18,054	.51	9,224
1967	18,423	.55	10,048
1968	18,731	.52	9,804
1969	18,605	.52	9,721
1970	17,374	.47	8,105
1971	16,777	.46	7,722
1972	15,513	.45	6,968
1973	16,716	.54	9,097
1974	16,189	.64	10,414
1975	16,092	.59	9,504
1976	15,772	.67	10,524
1977	16,273	.73	11,818
1978	16,500	.73	12,000
1979	16,300	.70	11,400

1/ 1960 to 1969 production period was July 1 to June 30; 1970 to 1979 production period was November 1 to October 31.

Source: (42).

Table 44--Nigeria sorghum: Area, yield, and production

Year beginning July 1	Area harvested	Yield	Production
	<u>1,000 hectares</u>	<u>Metric tons</u>	<u>1,000 metric tons</u>
1960	4,675	0.86	4,000
1961	4,671	.85	3,966
1962	4,786	.94	4,509
1963	5,249	.78	4,069
1964	5,548	.76	4,239
1965	5,933	.71	4,235
1966	4,839	.65	3,160
1967	4,732	.72	3,389
1968	5,174	.55	2,821
1969	5,850	.70	4,080
1970	5,850	.70	4,080
1971	5,409	.58	3,140
1972	5,500	.65	3,561
1973	5,300	.56	2,968
1974	5,645	.62	3,500
1975	5,795	.62	3,590
1976	5,940	.62	3,680
1977	6,000	.63	3,750
1978	6,000	.63	3,770
1979	6,000	.63	3,785

Source: (42).

Table 45--Sorghum consumption, major consuming countries

[illegible]

1/ Year beginning July 1 for PRC, Japan, Mexico, other countries and world;  
October 1 for United States; July 1, 1960-69, and November 1, 1970-79 for India.

Source: (42).

Many countries have encouraged feed grain production in recent years to support expanding livestock industries. As those countries upgrade diets with more livestock, poultry, and dairy production, the demand for coarse grains will continue to rise. The relative importance of sorghum as a grain crop in various world regions is shown in table 36. World sorghum production accounted for 9 percent of coarse grain production and 4 percent of total grain production in 1979. The developed countries will likely continue to supply feed grains to developing countries in which the demand for livestock products is increasing.

Feed characteristics are most important in countries that use a high proportion of cereal in their feed rations, as in Japan. The feed characteristics of sorghum give it a wide range of potential feed uses, but they also make it readily substitutable by other grains and feedstuffs as circumstances warrant (table 16).

The Food and Agriculture Organization of the United Nations (FAO) found that, with the ease of substitution on technical grounds, the demand for sorghum was highly variable, depending on a wide variety of conditions in importing countries (4). Those conditions include (1) the cereal/livestock price relationship, (2) the price relationships between sorghum and other feed grains, particularly corn, (3) the price relationships between cereals and other feedstuffs, (4) the composition of the entire animal ration, including the share of oilmeals and other high protein meals, (5) traditional feeding habits, (6) the importance of mixed feed in livestock feeding, since mixed feed manufacturers react more promptly to changes in market conditions than individual livestock farmers and are generally more inclined to include sorghum in their mixes if it is offered at a favorable price, (7) the suitability of individual grains for specific purposes, e.g. the pigmentation of broilers, (8) the degree and type of government intervention in the feed grain market, and (9) the degree of self-sufficiency in feed grains obtained in the importing country and the trend in the self-sufficiency ratio.

### Trade

Three major exporting countries--Argentina, Australia, and the United States--accounted for over 90 percent of world sorghum exports during 1973-79. Conversely, 10 major importing countries--Japan, Israel, India, Venezuela, Belgium-Luxembourg, the Netherlands, Mexico, Poland, Spain, and the United Kingdom--acquired more than 80 percent of the sorghum imports during the same period.

World trade of sorghum has quadrupled from 1960 to 1976, fluctuating from a low of 2.7 million metric tons in 1960 to a high of 12.0 million metric tons in 1976 (table 37). World trade was around 11 million metric tons in 1977 to 1979. The United States retained its share among the major exporting countries, remaining at about 62 percent of the world trade share (table 47). U.S. exports have been unstable, however. Exports were at a low of 1.8 million metric tons in 1960, reached a high of 6.8 million metric tons in 1965, steadily dropped to 2.7 million metric tons in 1968, gradually increased to 6.2 million metric tons in 1976, declined to 5.4 million metric tons in 1977, and rose to 5.8 million metric tons in 1979.

Sorghum exports from Argentina increased nearly tenfold between 1960 and 1977 (table 47). However, year-to-year variations have fluctuated in a manner similar to those exports from the United States. In the early sixties, Argentina exported slightly over one-third of its total sorghum production. By the late seventies, Argentina was exporting nearly two-thirds of its total sorghum disappearance.

Australia, the current third largest sorghum exporter, increased in importance as an exporter only in the seventies, going from 0.3 million metric tons in 1969 to 1 million metric tons in 1973 and 1975 (table 47). During those 2 years, Australia exported nearly 90 percent of its total sorghum disappearance.



Table 46--World sorghum trade between major exporting and importing countries, annual average for July to June, 1973 to 1976

Import destination	Export origin					Total
	United States	Argentina	Australia	Thailand	Other countries	
	<u>1,000 metric tons</u>					
Belgium-Luxembourg	285	172	0	0	59	516
India	281	214	0	16	0	511
Israel	647	18	0	0	0	665
Japan	2,511	1,048	744	26	32	4,361
Mexico	344	120	0	0	0	464
Netherlands	388	246	1	0	77	712
Poland	243	143	0	0	0	386
Spain	76	408	0	0	4	488
United Kingdom	22	25	17	0	319	383
Venezuela	410	76	0	0	0	486
Other countries	719	746	122	142	201	1,930
Total	5,926	3,216	884	184	692	10,902

Source: (42).

Sorghum exports are affected by the availability of other feed grains. Corn normally accounts for two-thirds of total coarse grain exports, with barley holding about 18 percent of coarse grain share. Along with increased world production, sorghum increased from an average of 10.9 percent of total coarse grain exports during 1960-64, to an average of 13.2 percent during 1973-78. During the last 5 years, corn had an average share of 68.4 percent; barley, 15.7 percent; oats, 1.6 percent; and rye, 0.7 percent. The general decline of all feed grains relative to corn reflects the stronger export demand for corn developing in recent years.

Sorghum exports increased in line with the growing world demand for feed grains, but the patterns of sorghum imports by individual regions and countries varied widely. The variation existed between countries and over time. Sorghum imports by Japan have been particularly large (table 48). Japan produces no sorghum and must depend on imports. Japan's sorghum imports increased from 114,000 metric tons in 1960 to 5.2 million metric tons in 1977. The United States supplied 2.4 million metric tons to Japan in 1977. Sorghum imports by the European Community (EEC) were large in the

Table 47--Sorghum exports by country

Year 1/	United States	Argentina	Australia	Other countries	World
<u>Million metric tons</u>					
1960	1.8	0.5	<u>2/</u>	0.4	2.7
1961	2.5	.5	0.1	.1	3.2
1962	2.9	.7	<u>2/</u>	.3	3.9
1963	2.7	.8	<u>2/</u>	.4	3.9
1964	3.8	.2	<u>2/</u>	.4	4.4
1965	6.8	1.3	.1	.3	8.5
1966	6.3	.4	<u>2/</u>	.6	7.3
1967	4.2	.8	.1	.9	6.0
1968	2.7	1.4	<u>2/</u>	.6	4.7
1969	3.2	1.6	.3	.6	5.7
1970	3.7	2.2	1.1	.8	7.8
1971	3.1	.5	.7	.6	4.9
1972	5.4	2.4	.6	.4	8.8
1973	5.9	2.8	1.0	1.1	10.8
1974	5.4	2.4	.9	.9	9.6
1975	5.8	3.5	1.0	1.5	11.8
1976	6.2	4.3	.5	1.0	12.0
1977	5.4	4.4	.2	1.0	11.0
1978	5.6	4.1	.7	.7	11.1
1979	5.8	2.7	1.8	.8	10.1

1/ Year beginning July 1 for world and other countries; October 1 for United States; April 1 for Argentina; and April 1, 1960-79, and December 1, 1979 for Australia.

2/ Less than 0.05 million metric tons.

Source: (42).

Table 48--Sorghum imports by country

Year 1/	Japan	EEC	Israel	Mexico	Other countries	World
Million metric tons						
1960	0.1	1.9	0.2	<u>2/</u>	0.5	2.7
1961	.3	2.0	.2	<u>2/</u>	.7	3.2
1962	.5	2.1	.1	0.2	1.0	3.9
1963	1.0	2.2	.2	<u>2/</u>	.5	3.9
1964	1.3	2.3	.2	.1	.5	4.4
1965	1.7	2.6	.2	.1	3.9	8.5
1966	2.7	2.5	.4	<u>2/</u>	1.7	7.3
1967	2.5	1.4	.4	.1	1.2	5.6
1968	2.5	1.0	.4	<u>2/</u>	.8	4.7
1969	3.2	.7	.5	<u>2/</u>	1.3	5.7
1970	4.2	1.6	.5	<u>2/</u>	1.5	7.8
1971	3.6	.7	.5	.1	0	4.9
1972	3.6	.5	.6	.2	3.9	8.8
1973	4.3	1.7	.6	.2	4.0	10.8
1974	4.0	1.7	.7	.6	2.5	9.5
1975	3.8	2.5	.6	.3	4.6	11.8
1976	5.0	1.7	.7	.8	4.2	12.4
1977	5.2	.6	.8	.6	3.3	10.5
1978	4.8	.4	.6	1.2	2.8	9.8
1979	4.9	.3	.7	1.1	3.2	10.2

1/ Year beginning July 1 for Japan, Israel, Mexico, other countries, and world; August 1 for the EEC. 2/ Less than 50,000 metric tons.

Source: (42).

early sixties, declined sharply in the late sixties, returned to a large volume in the midseventies, but fell again in the late seventies (table 48). The EEC produced most of its sorghum needs in 1979. Israel and Mexico have gradually increased sorghum imports since 1960. The United States supplies most of both countries' imports.

#### POLICY

U.S. agriculture has long been influenced by Government farm programs and sorghum is generally affected by national legislation involving feed grains, although very little legislation has focused directly on the crop itself. The Federal Farm Board, established in 1929, helped stem the decline of farm prices by making loans to cooperative associations and stabilization corporations for the purpose of controlling surpluses through purchases in an attempt to encourage orderly marketing. The primary impact came after the Agricultural Adjustment Act of 1933 was passed to reduce production and raise prices.

Subsequent agricultural acts during the midthirties attempted to boost farm incomes, which had fallen to one-third of the 1929 levels, through devices such as nonrecourse loans, marketing quotas, production controls, income parity, and price parity. The Agricultural Adjustment Act of 1938 became the model for subsequent farm commodity

programs. New features included (1) nonrecourse loans for producers of corn, wheat, and cotton, (2) crop insurance for wheat, and (3) payments to corn, cotton, rice, tobacco, and wheat farmers that would provide returns nearly equal to parity, as available funds would permit.

A specific formula regulated loan rates on corn. Loan rates were to be 75 percent of parity if the supply was not expected to exceed a year's domestic use and exports. The plan was to maintain an "ever-normal granary," providing reserve stocks for emergencies.

Marketing quotas and acreage allotments were established for the basic commodities: wheat, corn, tobacco, and cotton. Sorghum was a nonbasic commodity. Improved yields due to new hybrids partially compensated for reduced acreages, particularly in corn. The higher yields caused surpluses to accumulate and farm prices to fall 20 percent from 1938 to 1940.

Efforts were made to expand demand for farm commodities just prior to World War II. Four regional laboratories were established to develop new ways to use farm products. Direct distribution of surplus farm commodities to the needy, a school lunch program, a low-cost meals program, and a food stamp plan were initiated by the Government.

### War Measures

CCC stocks accumulated under the "ever-normal granary" during World War II reflected a changed emphasis from restraining production to encouraging production with high price guarantees. The support rate was raised in the Stabilization Act of October 1942 to 90 percent of parity for corn, cotton, peanuts, rice, tobacco, wheat, and the nonbasic commodities defined under the Steagall Amendment of July 1, 1941. However, the rate of 85 percent of parity could be used for any commodity if the President determined that the lower rate was required to prevent an increase in the cost of livestock and poultry feed and in the interest of national defense. To prevent farm incomes from sharply declining after the war, legislation in 1942 provided support for basic commodity prices at 90 percent of parity for 2 years immediately succeeding January 1 following a Presidential or congressional declaration that hostilities had ceased.

### Postwar Transition

The wartime price supports of the 1942 Stabilization Act were to cease December 31, 1948. Price supports were to drop to a range of 52 to 75 percent of parity as provided in the Agricultural Adjustment Act of 1938, with only discretionary support for nonbasic commodities. However, the Agricultural Adjustment Act of 1948 established mandatory price supports at 90 percent of parity for wheat, corn, rice, peanut, cotton, and tobacco crops marketed before June 30, 1950. The supports would be available if producers approved marketing quotas.

The parity formula was revised, correlating dependent parity prices with the market prices of agricultural commodities during the most recent 10-year period. Title II of the 1948 legislation provided for a sliding scale of price support for the basic commodities (except tobacco) between 60 and 90 percent of parity. The sliding scale, to have begun in 1950 if marketing quotas were in force, never became effective because the legislation was superseded by the Agricultural Act of 1949. The new legislation supported basic commodities at 90 percent of parity in 1950 and from 80 to 90 percent in 1951.

The 1949 Act also amended the 1948 parity formula by adding wages paid for hired labor to the parity index and by including wartime payments made to producers in the prices

of commodities and in the index of prices received. The effective parity price through 1954 for basic commodities was to be the old or the modernized 1948 formula, whichever was higher. The modernized formula became effective in 1950.

### Korean Conflict

The Korean conflict again necessitated the production of sufficient food and fiber for mobilized effort. Acreage allotments and marketing quotas were not in effect for 1951 and 1952 on corn, wheat, rice, and cotton. Grain sorghum, oats, barley, and rye prices were supported at 75 percent of parity in 1951 and 80 percent in 1952.

The conflict strengthened the case of congressional leaders who did not want flexible price supports due to increased demand for farm products. Mandatory price supports were, therefore, extended for the 1953 and 1954 crops.

### Postconflict Transition

Surpluses began to mount after the end of the Korean conflict. The Agricultural Trade and Assistance Act, better known as Public Law 480, was approved July 10, 1954. It provided financial assistance for farm exports and was of major importance in providing for disposal of farm surpluses in foreign countries. The act served as the basic authority for the sale of surplus agricultural commodities for foreign currency, for shipments of emergency relief, and for bartering farm products for strategic material.

The main features of feed grain programs affecting sorghum after 1950 involve price supports through CCC nonrecourse loans, acreage diversion, and set-aside programs.

Sorghum, oats, barley, and rye were included in the permissive price support strategy during the early fifties in which price supports could not exceed 90 percent of parity. Those grains were designated as nonbasic commodities in the Agricultural Act of 1956, with price support levels at 76 percent of parity on the 1956 crop and not less than 70 percent of parity on the 1957 crop.

The Agricultural Act of 1958 made price supports for most feed grains mandatory. The act required that, with the 1959 crop, price supports should be made available at a level determined by the Secretary of Agriculture to be fair and reasonable in relation to corn. Corn farmers voted in a referendum to discontinue acreage allotments for the 1959 and subsequent crops, and to receive supports at a maximum rate of 90 percent of the average farm price for the preceding 3 years, but not less than 65 percent of parity.

### Farm Programs, 1960-78

Sorghum acreage increased from 16 million acres in 1950 to almost 27 million acres in 1957. During this time, sorghum was produced on land made available by acreage restraints under the corn, wheat, and cotton programs. Prior to 1961, a farmer could plant any amount of sorghum and still obtain a price support loan. Sorghum acreage restrictions became a requirement for obtaining price supports in 1961. Sorghum acreage has not reached the high level of 1957 since acreage restrictions became effective (table 7).

Prior to 1961, winter wheat and cotton were important competitors with sorghum in Texas (21). Cotton competed with sorghum in California and Oklahoma. Winter wheat and sorghum plantings moved in opposite directions for many years in Texas, New Mexico,

Kansas, Oklahoma, Colorado, Nebraska, Missouri, and California. Corn and sorghum substitution was particularly important in Kansas, Nebraska, and Missouri.

Following the 1961 restrictions on sorghum acreage, no substitution was found between sorghum and wheat acreage during 1961-79 (21). Substitution between cotton and sorghum did appear. Acreage diverted under feed grain programs has also competed with sorghum plantings since 1961.

In evaluating the effect of Government policy on sorghum acreage, Ryan and Abel found price support rate, diversion payment rate, cotton acreage, wheat acreage, and soybean prices to be important influences on sorghum acreage (21).

The emergency Feed Grain Act was passed in March 1961 because of increasing surpluses. It established a special program for diverting corn and grain sorghum acreage to soil conserving crops or pasture. Producers were eligible for price supports at 74 percent of parity in 1961 if they devoted 20 percent of their 1959-60 corn and sorghum acreage to soil conserving uses. Legislation in the sixties continued to use acreage diversion for which producers received payments for diverting acreage from feed grains to conserving uses. Acreage diversion was the major means of controlling production.

The Agricultural Adjustment Act of 1970 was a voluntary 3-year program. To qualify for price support, farmers were required to keep a specific percentage of their cropland out of production. They could grow whatever they wanted on the remaining land except for certain quota crops. Payment limits were established at an annual ceiling of \$55,000 per crop, excluding commodity loans and purchases, for producers of upland cotton, wheat, and feed grains.

Demand for American farm products increased due to world crop shortages beginning in late 1972. By 1973, stocks had been depleted due to expanded effective demand, changes in USSR trade policy, and the devaluation of the dollar. The Agriculture and Consumers Protection Act of 1973 continued the Secretary of Agriculture's authority to establish cropland set-aside (and additional diverted acreage), but the act placed emphasis on production to respond to the "ever-growing worldwide demand for food and fiber." It encouraged higher production of feed grains with a concept of target prices and disaster coverage, with payments based on allotted acres.

The target price for sorghum, a shift from the parity concept, was set at a level which the Secretary determined fair and reasonable in relation to the rate at which target levels were set for corn. The target price for corn was prescribed by law for 1974 and 1975 at \$1.38 per bushel. For the 1976 and 1977 crops, the target price for corn was adjusted to reflect any change during the previous calendar year in the index of prices paid by farmers for production items, interest, taxes and wage rates, and with adjustment, as needed, to reflect any change in the national average yield. The target price for sorghum was set at 95 percent of the target price for corn during these 4 years. However, the 1977 farm bill increased the 1977 target price to \$4.07 per hundredweight, 114 percent of the corn target price.

Deficiency payments were provided if the average market price received by farmers during the first 5 months of the marketing year dropped below the target level. Payment rates would be equal to the amount by which market prices fell below target prices, but could not exceed the difference between target prices and price support loans. The act provided for loans to producers at levels below target prices to encourage greater reliance on the market price.

The Food and Agriculture Act of 1977 continued the dual target price and loan rate system, providing price and income support protection to farmers through the 1981 crop year. However, the 1977 Act modified the basis for determining target price.

The 1973 Act adopted a cost of production standard as a basis for annual adjustments in the target price. Lack of adequate data on costs led to the use of the index of prices paid for production items, interest, taxes and wage rates and changes in the 3-year moving average of individual crop yields for annual adjustments. To provide a basis for the future, the 1973 Act directed the Secretary to establish current weighted national average cost of production for the major program commodities and dairy products. These studies became the basis for the target prices adopted in the 1977 Act.

Target prices for 1978 were based on costs of production for 1975 and 1976 (variable, machinery ownership, and general farm overhead costs) including a return to management and a 3- to 4-percent return to land on the current price of land. The 1977 Act further revised the 1973 Act by specifying that the annual adjustments to target price be based on individual commodity production costs, rather than on the prices paid index. The 1978 target price for sorghum, set at \$4.07 per hundredweight, was 109 percent of the target price for corn. This departs from the 95-percent relationship followed in the 1973 Act and could have some regional structural impacts over time.

The White House announced that a 10-percent set-aside would be required for participation in the 1978 feed grain program. Participation was voluntary, but was required for eligibility of price support loans, income support payments, and crop disaster protection. Participants were required to have a set-aside equal to 10 percent of their 1978 total plantings of corn, sorghum, and barley for harvest. For example, a farmer with 100 planted acres of sorghum must have had 10 acres of set-aside devoted to soil conserving uses.

Farmers could receive land diversion payments on their 1978 feed grain crops if they diverted 10 percent in addition to the set-aside required for participation in the program. This would total 20 percent of their 1978 plantings. Also, 1978 planted acreage of these crops could not exceed 1977 planted acres. Diversion payments were 20 cents per bushel for corn and 12 cents per bushel for sorghum and barley. Payments were calculated by multiplying these rates by the farms' established yields times the actual acreages planted for harvest.

The Food and Agriculture Act of 1977 required the Secretary of Agriculture to administer a producer-held storage program for wheat and, at the Secretary's discretion, a similar program for feed grains. The 1976 and 1977 grain under Government loan was eligible for the 3-year grain reserve program. The reserve was used to stabilize grain prices by releasing stocks during periods of excessively high prices and by removing grain from the market when prices were low. Participation in this producer held program was voluntary. The Government paid annual storage payments of 25 cents per bushel for sorghum, wheat, corn, and barley, and 19 cents per bushel for oats. Farmers agreed to hold their feed grains in reserve at least until prices reached 125 percent of whatever the loan level was at the time (140 percent for wheat). Loans on feed grains would be called when prices reached 140 percent of the loan rate (175 percent for wheat). A sorghum producer would be subject to a penalty if the loan was redeemed before the market price reached 125 percent of the current loan. The Secretary was required to recover storage payments and to assess penalty interest or other charges.

#### Program Costs

From the early thirties until the midsixties, the primary means for protecting farmers' incomes was price support loans. These were initially established above market clearing levels, without restrictions on production. Surpluses accumulated and it was then necessary to adopt production controls: individual marketing quotas and acreage allotments, and amounts of land to be withheld from production. The high support levels allowed foreign competitors to consistently undersell the United States in world markets; the United States became a residual supplier. The high price supports and rigid

programs led to high Government-held stocks by the early sixties (table 50). In an effort to make the programs more responsive to market conditions, programs to supplement the price support loans with so-called "price support payments" for certain commodities produced under quotas or allotments were first initiated. The quantity of sorghum acquired by the CCC dropped sharply in the midsixties (table 49).

The shift from program restrictions and toward greater reliance on market signals to guide producers continued when price and income supports were fully separated with the 1973 Act. Target prices would provide income support and protect farmers from economic disaster when low prices occurred. Loan prices were established at levels that would keep U.S. commodities competitive in world markets.

Costs of Government programs affecting the sorghum industry were relatively small prior to fiscal year 1961 (table 50). A rapid buildup in the quantity owned by the CCC and placed in the loan programs in the late fifties and early sixties, coupled with a rise in the support price, sharply increased Government program costs in 1961. Inventory and loan operations remained the major cost items until fiscal year 1967 when PL-480 exports were sharply increased to remove surplus stocks. Producer payments were costly in the seventies when set-aside, acreage diversion, and disaster payments were available.



Table 49--U.S. sorghum price support operations

Year beginning October 1	Support price		Put under support 1/		Quantity acquired by CCC	Quantity owned by CCC,
	Amount per	Percentage	Quantity	Percentage	under support	September 30
	hundredweight	of parity 2/		of production	program 3/	
	Dollars	Percent	Million hundredweight	Percent	Million hundredweight	
1950	1.87	65	33.8	25.8	9.8	9.6
1951	2.17	75	8.4	9.2	.2	.3
1952	2.38	80	2.1	4.1	.5	0
1953	2.43	85	25.6	39.4	22.9	12.2
1954	2.28	85	64.1	48.6	61.7	38.1
1955	1.78	71	59.5	43.7	51.9	42.1
1956	1.97	75	22.3	19.4	18.4	42.0
1957	1.86	70	164.3	51.7	156.5	165.2
1958	1.83	68	154.4	47.5	144.5	269.6
1959	1.52	60	64.4	20.7	53.9	307.2
1960	1.52	61	113.6	32.7	97.9	372.8
1961	1.93	78	109.9	40.9	108.5	351.4
1962	1.93	77	122.8	43.0	121.5	351.0
1963	4/ 2.00	80	79.2	24.2	71.7	344.5
1964	4/ 2.00	82	46.4	16.9	42.0	302.1
1965	4/ 2.00	81	59.4	15.8	47.8	184.0
1966	4/ 2.05	80	15.5	3.9	.2	108.2
1967	4/ 2.14	83	36.6	8.6	5.6	107.8
1968	4/ 2.14	80	41.3	10.1	7.8	5/ 110.6
1969	4/ 2.14	76	23.2	5.7	2.0	5/ 87.6
1970	4/ 2.14	73	17.1	4.5	3.8	5/ 35.1
1971	4/ 2.21	71	86.5	17.6	1.0	5/ 21.9
1972	4/ 2.39	71	16.7	3.7	0	5/ 2.7
1973	4/ 2.61	66	10.4	2.0	0	0
1974	4/ 2.34	50	2.2	.6	0	0
1975	4/ 2.34	45	4.9	1.2	0	0
1976	4/ 2.66	49	11.8	1.6	.1	0
1977	4/ 6/ 4.07	71	121.5	27.4	23.0	7.3
1978	4.07	65	51.5	12.3	1.1	24.6

-- = Not available.

1/ Represents loans made, purchases, and purchase agreements entered into.

2/ Percentage of the parity price as of the beginning of the marketing year.

3/ Includes deliveries from original program, the resale program and over-deliveries as determined by weight of farm-stored grain when delivered to CCC.

4/ Includes price support payments per hundredweight of 29 cents in 1963, 23 cents in 1964, 35 cents in 1965, 53 cents in 1966 through 1970, 51 cents in 1971, 68 cents in 1972, and 54 cents in 1973. Payments were made in a designated portion of the base. Loan level protection in 1974 and 1975 was \$1.88 and in 1976 and 1977 was \$2.55 on entire production. The target level for 1974 to 1977 was a price guarantee on allotment production at levels indicated under support price.

5/ Uncommitted CCC inventory.

6/ The 1977 target price was originally set at \$2.89. The Food and Agriculture Act of 1977 raised the target price to \$4.07.

Table 50--Realized losses on Government programs affecting  
the sorghum industry 1/

Year ending June 30	Price support and other related programs			Public Law 480	Other export programs	Total 5/
	Inventory and loan operations	Producer payments	Other			
Million dollars						
1932-49	3.2	0	0	0	0	3.2
1950	10.5	0	0	0	0	10.5
1951	22.6	0	0	0	0	22.6
1952	4/	0	0	0	0	4/
1953	2/ .9	0	0	0	0	2/ .9
1954	7.3	0	0	0	0	7.3
1955	21.2	0	21.0	1.9	0	44.0
1956	55.0	0	8.3	7.5	0	70.9
1957	9.9	0	17.5	0	0	27.5
1958	22.1	0	.9	11.2	0	34.2
1959	26.4	0	11.1	25.6	0	63.1
1960	18.0	0	3.8	18.2	0	39.9
1961	290.1	0	4.0	21.6	4/	315.7
1962	126.9	0	2.8	19.5	4/	149.3
1963	125.9	0	4/	15.5	4/	141.5
1964	75.4	0	.3	7.1	0	82.8
1965	68.4	0	.2	12.2	4/	80.9
1966	98.7	0	0	71.0	0	169.7
1967	2/ 24.7	0	0	243.6	0	218.9
1968	24.0	0	4/	71.2	4/	95.3
1969	31.4	0	0	27.1	0	58.5
1970	29.4	232.9	0	31.9	0	294.2
1971	10.9	236.3	0	34.9	1.4	283.4
1972	7.8	166.4	.2	40.7	.6	215.9
1973	2/ 14.9	285.6	5.0	47.1	2.7	325.5
1974	2/ 17.5	179.3	.2	84.1	1.1	247.1
1975	2/ 4.0	68.0	2/ .1	35.2	5.6	104.8
1976 3/	2/ .5	21.1	4/	32.2	17.6	70.4
1977 3/	2/ .3	34.5	4/	20.5	28.4	83.1
1978 3/	1.0	171.9	2.5	29.6	45.5	250.5

1/ The term realized losses refers to the costs incurred by CCC in financing various farm programs. These data exclude administrative costs and receipts from Public Law 480 sales.

2/ Denotes a gain.

3/ Fiscal year changed from July 1-June 30 to October 1-September 30. 1976 data include July-September data also.

4/ Less than 50,000.

5/ Totals may not add due to rounding.

Source: (31).

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Appendix table 1--Sorghum supply and use, United States

Year beginning October 1 and quarter 1/	Supply			Use					Ending stocks
	Beginning stocks	Production	Total	Domestic use			Exports	Total disappear- ance	
				Feed	Food industry and seed	Total			
Million bushels									
1965-1966:									
October-December	566	673	1,239	208	3	211	50	261	978
January-March	978	--	978	178	3	181	73	254	724
April-May	724	--	724	80	3	83	43	126	598
June-September	598	--	598	102	5	107	100	207	391
Marketing year 2/	566	673	1,239	569	13	582	266	848	391
1966-1967 :									
October-December	391	715	1,106	207	3	210	75	285	821
January-March	821	--	821	227	3	230	65	295	526
April-May	526	--	526	83	3	86	45	131	395
June-September	395	--	395	82	5	87	64	151	244
Marketing year 2/	391	715	1,106	601	13	614	248	862	244
1967-1968 :									
October-December	244	755	999	209	3	212	55	267	732
January-March	732	--	732	164	3	167	48	215	517
April-May	517	--	517	84	3	87	16	103	414
June-September	414	--	414	73	5	78	47	125	289
Marketing year 2/	244	755	999	531	13	544	166	710	289
1968-1969 :									
October-December	289	731	1,020	248	3	251	28	279	741
January-March	741	--	741	181	3	184	16	200	541
April-May	541	--	541	89	3	92	13	105	436
June-September	436	--	436	95	5	100	49	149	287
Marketing year 2/	289	731	1,020	614	13	627	106	733	287
1969-1970 :									
October-December	287	730	1,017	297	3	300	29	329	688
January-March	688	--	688	151	1	152	33	185	503
April-May	503	--	503	91	2	93	11	104	399
June-September	399	--	399	99	3	102	53	155	244
Marketing year 2/	287	730	1,017	638	9	647	126	773	244

See footnotes at end of table.

Continued

Appendix table 1--Sorghum supply and use, United States--Continued

Year beginning October 1 and quarter 1/	Supply			Use					Ending stocks
	Beginning stocks	Production	Total	Domestic use			Exports	Total disappear- ance	
				Feed	Food industry and seed	Total			
Million bushels									
1970-1971:									
October-December	244	684	928	264	2	266	51	317	611
January-March	611	--	611	202	1	203	52	255	356
April-May	356	--	356	106	3	109	9	118	238
June-September	238	--	238	114	3	117	31	148	90
Marketing year 2/	244	684	928	684	10	694	144	838	90
1971-1972:									
October-December	90	876	966	248	2	238	19	257	709
January-March	709	--	709	197	2	199	30	229	480
April-May	480	--	480	113	2	115	17	132	348
June-September	348	--	348	145	3	148	58	206	142
Marketing year 2/	90	876	966	692	9	701	123	824	142
1972-1973:									
October-December	142	809	951	282	1	283	47	330	621
January-March	621	--	621	199	1	200	58	258	363
April-May	363	--	363	80	2	82	28	110	253
June-September	253	--	253	99	2	101	79	180	73
Marketing year 2/	142	809	951	660	6	666	212	878	73
1973-1974:									
October-December	73	930	1,003	301	1	302	56	358	645
January-March	645	--	645	197	1	198	66	264	381
April-May	381	--	381	99	2	101	35	136	245
June-September	245	--	245	104	3	107	77	184	61
Marketing year 2/	73	930	1,003	701	7	708	234	942	61
1974-1975:									
October-December	61	629	690	262	1	263	46	309	381
January-March	381	--	381	108	1	109	63	172	209
April-May	209	--	209	59	2	61	17	78	131
June-September	131	--	131	8	2	10	86	96	35
Marketing year 2/	61	629	690	437	6	443	212	655	35

See footnotes at end of table.

Continued



Appendix table 1--Sorghum supply and use, United States--Continued

Year beginning October 1 and quarter 1/	Supply			Use					Ending stocks
	Beginning stocks	Production	Total	Domestic use			Exports	Total disappear- ance	
				Feed	Food industry and seed	Total			
Million bushels									
1975-1976:									
October-December	35	760	795	256	1	257	63	320	474
January-March	475	--	475	157	1	158	68	226	248
April-May	248	--	248	72	1	74	20	94	154
June-September	154	--	154	23	1	25	77	102	51
Marketing year 2/	35	760	795	508	4	514	228	742	51
1976-1977:									
October-December	52	724	775	220	1	221	62	283	493
January-March	494	--	494	112	1	113	83	196	297
April-May	296	--	296	64	1	66	34	100	197
June-September	196	--	196	36	1	38	67	105	91
Marketing year 2/	52	724	775	432	4	438	246	684	91
1977-1978:									
October-December	91	793	884	208	1	209	56	265	619
January-March	619	--	619	136	1	137	68	205	414
April-May	414	--	414	56	2	58	36	94	320
June-September	320	--	320	73	2	76	54	129	191
Marketing year 2/	91	793	884	473	6	480	214	694	191
1978-1979:									
October-December	191	748	939	250	1	251	47	298	641
January-March	641	--	641	152	1	153	68	222	419
April-May	419	--	419	66	2	68	28	96	323
June-September	323	--	323	98	2	100	64	164	159
Marketing year 2/	191	748	939	566	7	573	207	779	159

-- = Not available.

1/ Adjusted for July 1 to June 1 shift in reporting grain stocks.

2/ Data may not add to totals due to independent rounding.

Source: (37).

Appendix table 2--Monthly average price of no. 2 yellow sorghum at Kansas City

Year beginning October 1	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Average
<u>Dollars per hundredweight</u>													
1965	1.86	1.87	1.92	1.97	2.00	1.95	1.95	1.95	1.96	2.11	2.13	2.10	1.98
1966	1.99	2.03	2.10	2.10	2.10	2.17	2.14	2.16	2.21	2.21	2.02	2.07	2.11
1967	1.90	1.89	1.93	2.03	2.10	2.10	2.07	2.04	1.97	1.91	1.76	1.77	1.96
1968	1.82	1.91	1.89	1.94	1.93	1.92	1.96	2.00	2.02	2.06	2.09	2.08	1.97
1969	2.08	2.06	2.05	2.06	2.04	1.96	2.00	1.96	2.03	2.09	2.18	2.29	2.07
1970	2.22	2.12	2.27	2.37	2.35	2.32	2.41	2.46	2.58	2.53	2.25	1.91	2.32
1971	1.80	1.91	2.06	2.06	2.07	2.07	2.09	2.08	2.06	2.11	2.05	2.21	2.05
1972	2.17	2.42	2.88	3.06	2.88	2.86	2.83	3.09	3.61	3.93	4.72	4.37	3.24
1973	4.37	4.31	4.37	4.71	4.99	4.64	4.03	3.84	3.99	5.02	5.79	5.64	4.64
1974	6.32	6.10	5.36	4.95	4.55	4.48	4.64	4.60	4.53	4.82	5.13	4.66	5.01
1975	4.53	4.36	4.33	4.36	4.47	4.62	4.47	4.47	4.66	4.73	4.29	4.27	4.46
1976	3.88	3.60	3.77	3.91	3.85	3.75	3.62	3.53	3.28	3.15	2.73	2.78	3.49
1977	3.05	3.40	3.36	3.37	3.49	3.78	3.92	3.92	3.82	3.54	3.41	3.43	3.54
1978	3.61	3.67	3.64	3.71	3.73	3.77	3.81	3.92	4.41	4.89	4.44	4.34	4.00
1979	4.42	4.41	4.57	4.21	--	--	--	--	--	--	--	--	--

-- = Not available.

Source: (37).

Appendix table 3--Whole grain weights, measures, and conversion factors

Grain	Pounds per bushel	Bushels	
		Per metric ton	Per quintal
	<u>Pounds</u>	<u>Bushels</u>	
Barley	48	45.9296	4.59
Buckwheat	48	45.9296	4.59
Corn:			
Shelled	56	39.6383	3.96
Ear husked	70	31.4946	3.15
Flaxseed	56	39.6383	3.96
Oats:			
Light	32	68.8945	6.89
Heavy	38	58.0164	5.80
Rice, rough	45	48.9916	4.90
Rye	56	39.6383	3.96
Sorghum grain	56	39.6383	3.96
Soybeans	60	36.7437	3.67
Wheat	60	36.7437	3.67

## Miscellaneous factors:

Rice: 1 hundredweight of rough rice = 2.2 bushels

1 barrel of rough rice = 162 pounds or 3.60 bushels

Sorghum grain: 1 hundredweight of sorghum grain = 1.78 bushels

Soybeans: 1 hundredweight of sorghum grain = 1.78 bushels

1 metric ton = 22.046 hundredweight

1 metric ton = 2,204.623 pounds

1 short ton or ton = 2,000 pounds

1 long ton = 2,240 pounds

1 quintal = 220.46 pounds

10 quintals = 1 metric ton

1 hectare = 2.471 acres

Source: (9).

Appendix table 4--U.S. sorghum exports by country of destination <sup>1/</sup>

Region/ country	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979
<u>1,000 metric tons</u>											
North America:											
Mexico	27	22	84	185	180	563	246	362	496	900	900
Other	--	5	--	--	9	12	--	40	88	24	30
Total	27	27	84	185	189	575	246	402	584	924	930
South America:											
Columbia	14	2	--	21	37	20	--	74	18	--	--
Venezuela	47	265	275	365	437	384	464	420	275	350	350
Other	3	8	17	33	--	--	26	14	56	14	6
Total	64	275	292	419	474	404	490	508	349	364	356
Europe:											
EC	232	607	185	100	142	613	1,729	766	145	180	80
Norway	--	--	--	94	76	97	130	190	95	130	132
Poland	--	40	--	--	26	126	191	600	307	200	200
Portugal	--	--	--	84	40	151	109	433	359	325	325
Spain	--	24	46	1	16	17	59	205	436	250	250
Other	3	24	5	19	17	31	125	244	122	149	20
Total	235	695	236	298	317	1,035	2,343	2,438	1,464	1,234	1,007
USSR	--	--	--	1	1	--	--	--	--	--	--
Asia:											
India	169	7	8	468	536	9	623	--	--	--	--
Israel	542	520	550	593	583	720	592	684	708	600	600
Japan	1,948	2,553	1,149	2,665	3,199	2,176	2,316	2,684	2,408	2,400	2,400
Other	--	1	--	--	40	--	--	194	98	90	170
Total	2,659	3,081	1,707	3,726	4,358	2,905	3,531	3,562	3,214	3,090	3,170
Africa	22	38	71	69	188	37	23	12	91	10	15
Oceania	--	--	--	--	--	--	--	--	--	--	--
World	3,007	4,116	2,390	4,698	5,527	4,956	6,633	6,922	5,702	5,622	5,478

-- = None reported.

<sup>1/</sup> Year beginning July 1.

Source: (41).

Appendix Table 5--Sorghum placed under loan and purchased, total production, average price,  
and average amount loaned, United States

Year beginning October 1	Pledged for loans <sup>1/</sup>	Purchased by CCC	Total production for grain	Average market price	Average amount loaned
	----- Million bushels -----			Dollars per bushel	
1953	42.6	1.5	115.7	1.32	1.351
1954	110.9	2.6	235.6	1.26	1.335
1955	103.1	.2	242.6	.97	.976
1956	38.9	.4	204.9	1.15	1.102
1957	277.5	7.0	567.5	.97	1.102
1958	264.3	7.0	581.0	1.00	1.059
1959	106.9	2.9	555.4	.86	.880
1960	195.9	2.5	619.9	.83	.867
1961	189.4	5.2	479.8	1.01	1.113
1962	213.7	4.6	509.7	1.02	1.140
1963	139.3	.9	587.9	.97	.994
1964	82.7	.4	490.3	1.05	1.053
1965	106.0	.1	666.1	.99	.972
1966	27.7	--	720.4	1.02	.795
1967	65.4	--	765.6	.99	.847
1968	73.8	--	739.7	.95	.886
1969	41.5	--	747.3	1.07	.845
1970	30.5	--	696.5	1.14	.865
1971	154.5	--	875.8	1.05	.946
1972	29.8	--	809.3	1.37	.978
1973	18.6	5.0	930.0	2.14	.945
1974	3.9	2.8	629.2	2.78	1.083
1975	8.0	.8	760.1	2.37	1.036
1976	21.0	1.3	723.7	2.03	1.377
1977	212.7	5.0	790.6	1.76	1.945

-- = None purchased.

<sup>1/</sup> Includes quantities in purchase agreements placed under resale loans.

Source: (30).

Appendix table 6--Agricultural commodity support prices per unit, United States <sup>1/</sup>

Commodity	Unit	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974 <sup>2/</sup>	1975 <sup>2/</sup>	1976 <sup>2/</sup>	1977 <sup>2/</sup>	1978
<u>Dollars</u>															
<b>Mandatory: <sup>3/</sup></b>															
Corn--															
Support level <sup>4/</sup>	Bu.	1.25	1.30	1.35	1.35	1.35	1.35	1.35	1.41	1.64	1.38	1.38	1.57	2.00	2.10
Loan rate	do.	1.05	1.00	1.05	1.05	1.05	1.05	1.05	1.05	1.05	1.10	1.10	1.50	2.00	2.00
Wheat--															
Support level <sup>4/</sup>	do.	2.00	2.57	2.61	2.63	2.77	2.82	2.93	3.02	3.39	2.05	2.05	2.29	2.90	3.40
Loan rate	do.	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.37	1.37	2.25	2.25	2.35
Barley-- <sup>6/</sup>															
Support level <sup>4/</sup>	Cwt.	.96	1.00	.90	.90	1.03	1.03 <sup>6/</sup>	.81	1.10	1.27	1.13	1.13	1.28	2.15	2.26
Loan rate	do.	.80	.80	.90	.90	.83	.83	.81	.86	.86	.90	.90	1.22	1.63	1.63
Sorghum grain -- <sup>5/</sup>															
Support level <sup>4/</sup>	do.	2.00	2.05	2.14	2.14	2.14	2.14	2.21	2.39	2.61	2.34	2.34	2.66	4.07	4.07
Loan rate	do.	1.65	1.52	1.61	1.61	1.61	1.61	1.73	1.79	1.79	1.88	1.88	2.55	3.39	3.39
Oats <sup>5/</sup>	Bu.	.60	.60	.60	.63	.63	.63	.54	.54	.54	.54	.54	.72	1.03	1.03
Rye <sup>5/</sup>	do.	1.02	1.02	1.02	1.02	1.02	1.02	.89	.89	.89	.89	.89	1.20	1.70	1.70
<b>Nonmandatory:</b>															
Beans, dry edible	Cwt.	6.32	6.33	6.37	6.38	6.39	6.40	6.40	6.40	6.40	6.40	<sup>7/</sup>	<sup>7/</sup>	<sup>7/</sup>	<sup>7/</sup>
Cottonseed	Ton	43.00	48.00	48.00	48.00	37.00	37.00	<sup>7/</sup>	<sup>7/</sup>	<sup>7/</sup>	<sup>7/</sup>	<sup>7/</sup>	<sup>7/</sup>	<sup>7/</sup>	<sup>7/</sup>
Flaxseed	Bu.	2.90	2.90	2.90	2.90	2.75	2.50	2.50	2.50	2.50	2.50	<sup>7/</sup>	<sup>7/</sup>	<sup>7/</sup>	<sup>7/</sup>
Soybeans	do.	2.25	2.50	2.50	2.50	2.25	2.25	2.25	2.25	2.25	2.25	<sup>7/</sup>	2.50	3.50	4.50

<sup>1/</sup> National averages during the marketing years for the individual crops, beginning in the years shown.

<sup>2/</sup> Support level represents the statutory established price (the so-called target price).

<sup>3/</sup> Commodities are those which the CCC is required by law to support.

<sup>4/</sup> Represents the average loan rate plus any direct price-support payment (or, in the case of wheat, the value of the domestic marketing certificate) received by participants in the programs for the commodity. The basis of such payments varies among the crops and from year to year.

<sup>5/</sup> U.S. Grade No. 2 or better for barley and sorghum, and No. 3 for oats.

<sup>6/</sup> Payment rate dropped; support level and loan rate are the same.

<sup>7/</sup> No support program.

Source: (29).

Appendix table 7--Price supported commodities owned by CCC

Year ending December 1 <u>1/</u>	Barley	Corn	Sorghum	Oats	Rye	Wheat
			<u>Million bushels</u>			
1949	25	76	11	11	0.8	162
1950	28	399	45	12	.4	271
1951	16	389	11	7	.1	136
1952	3	280	<u>2/</u>	4	<u>3/</u>	132
1953	1	362	<u>2/</u>	2	.1	448
1954	11	606	15	24	2.3	749
1955	31	758	47	35	3.3	888
1956	41	984	60	34	6.3	840
1957	46	1,118	70	19	1.7	756
1958	72	1,168	288	26	2.0	777
1959	65	1,235	489	18	3.2	1,109
1960	56	1,471	557	11	4.3	1,133
1961	40	1,412	610	8	3.2	1,130
1962	28	1,044	579	15	1.0	1,045
1963	41	849	586	19	.9	982
1964	23	835	587	32	<u>2/</u>	712
1965	18	530	493	41	5.7	572
1966	7	156	332	47	8.2	216
1967	6	138	193	27	6.7	109
1968	6	260	192	46	9.0	100
1969	49	296	180	76	11.7	169
1970	28	215	163	146	17.6	283
1971	36	144	58	199	24.0	372
1972	10	140	37	172	29.8	267
1973	1	70	8	121	15.7	139
1974	<u>2/</u>	7	1	69	2.6	16
1975	<u>2/</u>	<u>2/</u>	<u>2/</u>	36	<u>2/</u>	<u>2/</u>
1976	0	<u>2/</u>	<u>2/</u>	3	<u>3/</u>	<u>2/</u>
1977	<u>3/</u>	1	1	<u>3/</u>	0	<u>34</u>

1/ Not necessarily from the crop of the year shown; may include quantities under resale from crop of previous years.

2/ Less than 500,000 bushels.

3/ Less than 50,000 bushels.

Source: (29).

Appendix table 8--Commodities outstanding under CCC price support loan

Year ending December 1	Barley	Corn	Sorghum	Oats	Rye	Wheat
1949	30	353	10	28	0.7	296
1950	28	185	17	13	1.2	172
1951	13	38	7	11	.4	156
1952	6	89	1	15	.1	336
1953	30	233	14	43	3.5	419
1954	83	152	99	46	5.3	357
1955	69	180	43	56	9.0	221
1956	50	215	17	35	2.1	199
1957	97	148	53	39	4.9	186
1958	82	249	101	70	6.9	474
1959	60	265	49	45	2.8	305
1960	59	373	80	35	3.3	383
1961	62	461	146	40	2.4	277
1962	36	560	156	33	4.7	259
1963	32	582	121	49	.9	173
1964	28	550	93	67	3.3	190
1965	20	459	108	73	4.7	181
1966	16	392	54	57	1.6	153
1967	38	418	67	56	1.5	252
1968	114	633	107	113	3.6	536
1969	106	567	76	194	4.8	706
1970	100	454	43	235	8.2	477
1971	108	761	114	223	14.8	486
1972	97	735	58	199	12.8	305
1973	22	190	14	46	.6	32
1974	4	49	2	3	.1	20
1975	6	110	6	3	.1	32
1976	12	206	16	4	2/	223
1977	65	765	157	60	.6	740

1/ Not necessarily from the crop of the year shown; may include quantities under resale from crop of previous years.

2/ Under 50,000 bushels.

Source: (29).



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